# Power Engineering

DECEMBER, 1953

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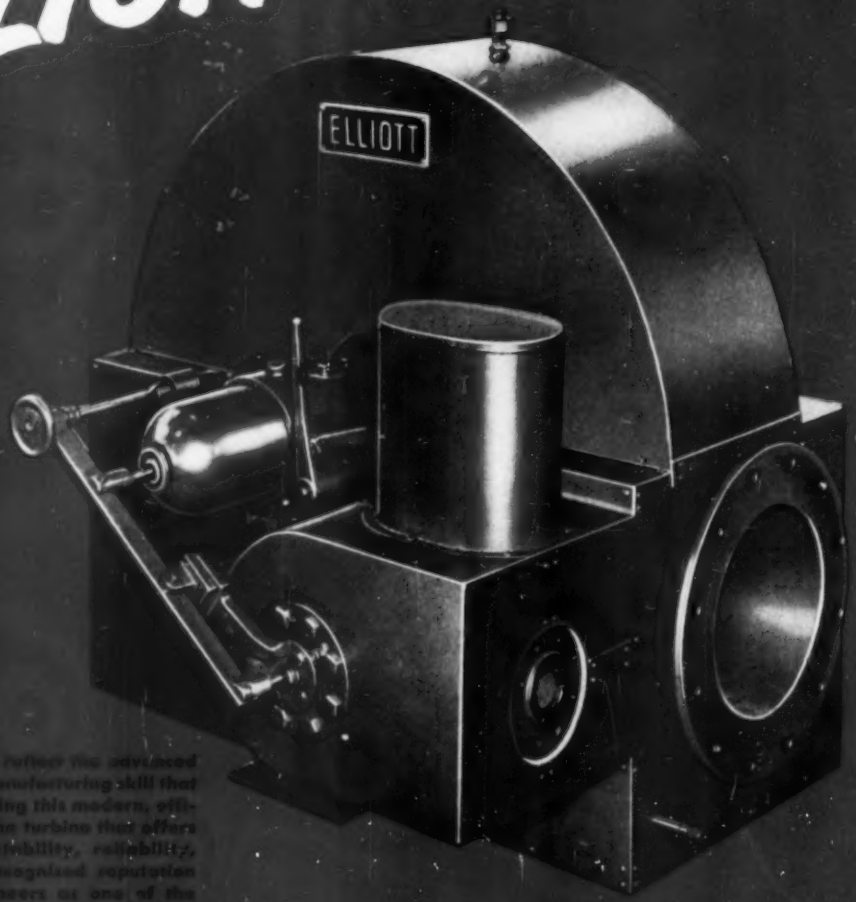
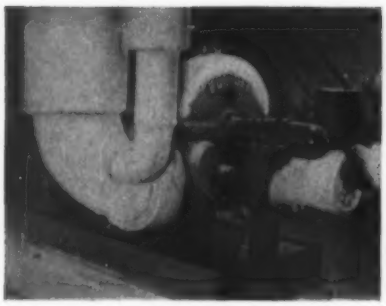
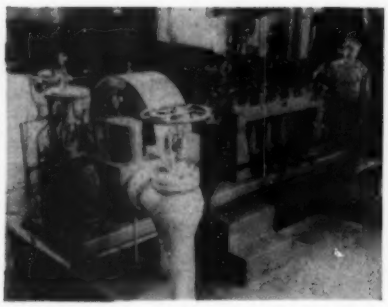
# ELLIOTT TURBINES



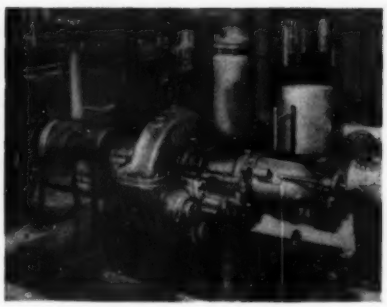

Clean, simple lines reflect the advanced engineering and manufacturing skill that has gone into building this modern, efficient turbine. It's the turbine that offers everything — adaptability, reliability, economy and a recognized reputation among plant engineers as one of the finest, most dependable turbines available anywhere.



Elliott 360-hp, 3550-rpm turbine driving a boiler-feed pump in a paper mill, exhaust steam being used in process.



Elliott 500-hp turbine driving a hydraulic system pump in a steel mill. Turbine maintains constant pump discharge pressure.



One of a group of Elliott turbines driving lean oil pumps in a cycling plant, where reliability is especially important.

# A standard turbine— yet "tailor-made" to your requirements

## Elliott Turbines can be adapted to practically any operating condition or service

That's because these powerful, compact turbines are designed to give you the advantages of custom-built adaptability at savings achieved through mass production of standardized parts. A wide variety of permissible modifications are possible. For instance... five sizes of YR turbines cover the entire range of capacities up to 2000 hp, speeds from 800 to 7000 rpm and back pressures from 4 in. Hg to 250 psig. Standard designs of rotor, governor, bearings, bearing cases, steam chest, governor valves and governor linkage are used throughout. In the case of higher pressures and temperatures up to 850 psig and 900 F, materials for steam parts may be changed from cast iron to steel.

Here are a few of the design highlights that are included in Elliott turbines:

**Air-wall labyrinth seals** to protect bearings from contamination without rubbing contact.

**Centerline support** to provide constant alignment under any operating condition.

**Stainless steel spray coating** under packing glands to eliminate corrosion of the shaft.

**Choice of many governors** to meet specific control requirements.

**Liner type bearings** to eliminate the need for scraping and fitting.

**Packing glands removable** without raising turbine upper half casing to simplify inspection and maintenance operations.

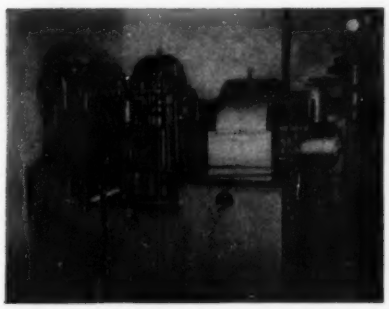
**Stainless steel buckets and shroud** to assure maximum life and continued high efficiency.

These and many other features are *standard* in Elliott turbines. They are the result of years of practical experience in the application of turbines to hundreds of different types of plant equipment and to many different types of operating and steam requirements.

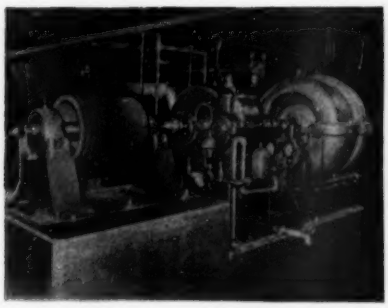
Full details on Elliott Mechanical Drive Turbines can be obtained from your local Elliott representative or by writing Elliott Company, Jeannette, Pa., for a descriptive bulletin.

**ELLIOTT Company**
***STEAM TURBINE DEPARTMENT***

H3-11



This Elliott 202-hp turbine drives an induced-draft fan through a separate reduction gear, in a midwestern generating station.

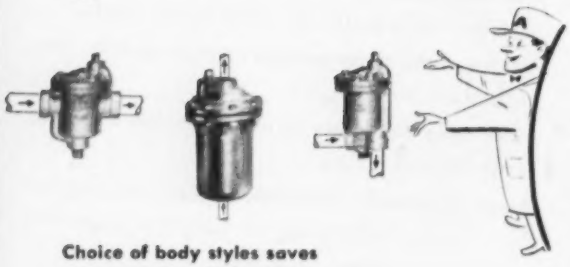


An Elliott 250-hp geared multi-stage turbine driving a paper machine. Governor gives close regulation over a wide speed range.

This line of oil pumps is driven by Elliott turbines. This is one of many refinery applications for Elliott turbines.

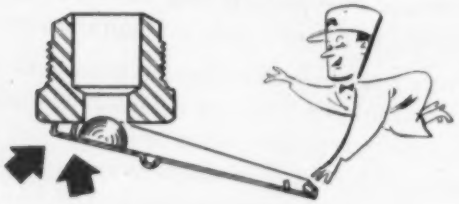
**For more data circle 501 on Post Card**

# How Armstrong Traps Save you Money



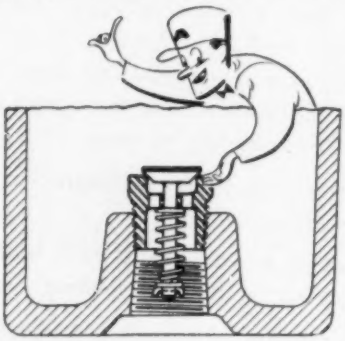
Choice of body styles saves money on installation costs.

Hardened, ground and lapped valve and seat; stainless steel mechanism resists wear and corrosion—saves money on maintenance.



Two phase leverage means higher capacity in a smaller trap. Armstrong traps have optimum relation between leverage, valve travel, bucket weight, capacity and overall size.

This internal check valve saves labor and fittings required to install regular check valve.



This trap with built-in strainer costs less than separate trap and strainer—requires less labor and fittings to install.

*Get the full facts on money-saving Armstrong traps. Send for free Catalog J. Clip and mail coupon today.*

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**Power Engineering**

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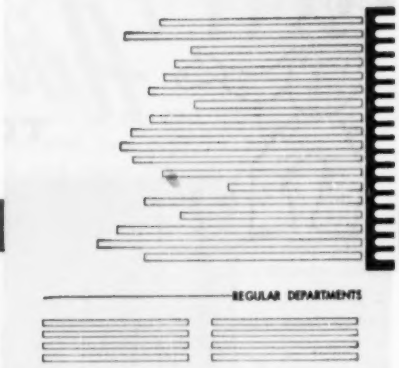


Artist's layout for our new cover, carrying complete contents, beginning January issue

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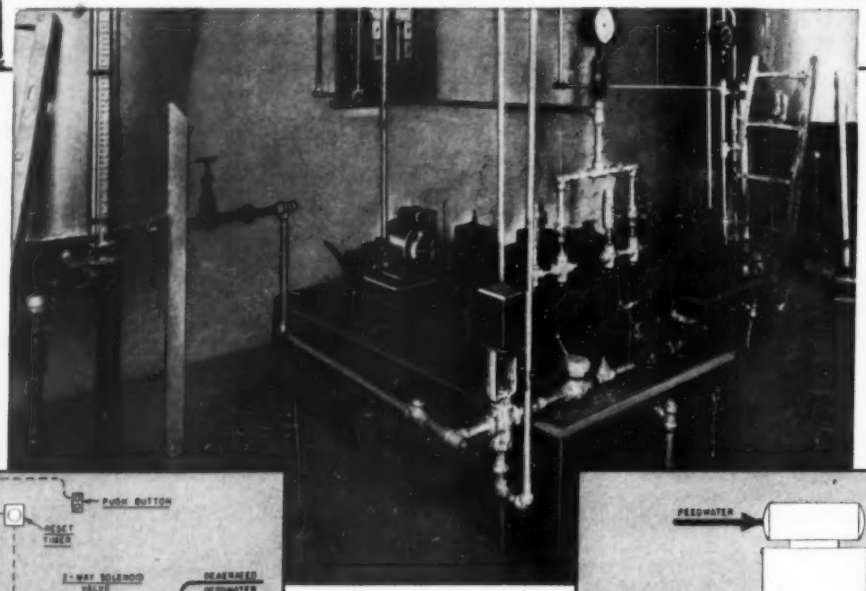
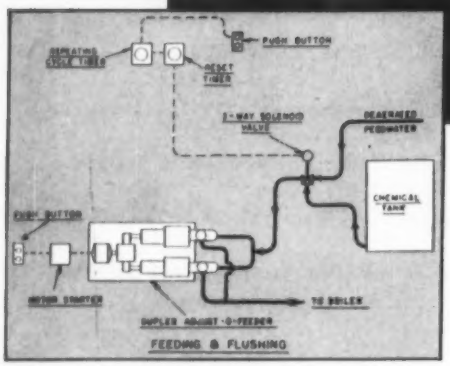
**The only magazine devoted exclusively to the job interests of power engineers**

# *Here's the combination*

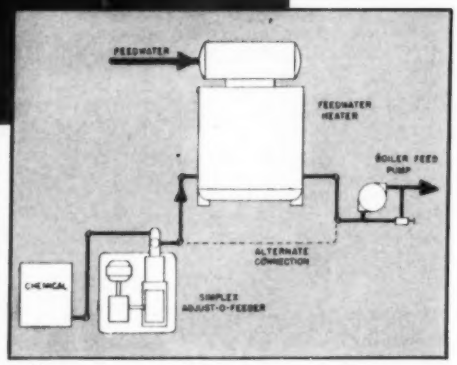
## TO TREAT YOUR BOILERS RIGHT






TO PREVENT CORROSION AND SCALE. *Continuous* or *intermittent* phosphate feed direct to the boiler drum.

%PROPORTIONEERS% equipment feeding sodium phosphate and sodium sulphite in the modern power plant of River Raisin Paper Co. at Monroe, Mich. Photo courtesy Pulp & Paper.




TO ELIMINATE OXYGEN IN FEEDWATER. *Constant Rate* sodium sulphite feed to the deaerater or feedwater heater.

%Proportioneers% Chemical Treating Systems automatically maintain the proper chemical feed for correct boiler water conditions. They reduce boiler maintenance, minimize operator responsibility, and provide positive control of chemical application. We offer standardized equipment and methods for time or flow-responsive control, including chemical feeders, special dissolving tanks, alarm systems, relief valves, automatic feeding and flushing valves, control panels, etc., to maintain top efficiency in power plant operation.

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# ENGINEERS' PREVIEW

OUR MOST abundant resource — air — may soon be used to provide home heat as well as cooling. This possibility is now close to reality, says the *Westinghouse Engineer*, November issue, in announcing a new heat pump for home use. It's an air-to-air unit, which means no water connections. It is entirely automatic in operation and it occupies only about 10 sq ft of floor space. Field trials in various parts of the country indicate that the comparative cost of operation of the unit related to fuel burning equipment depends on local cost of electricity. In general, where the electric rate is less than 2 cents per kwh, the heat pump is fully competitive with other methods of heating.

Certainly, if a heat pump of this type proves practical, it will solve the problem of providing water as a heat sink. Another factor that has tended to hold back the heat pump for home use is the difficulty of developing a small unit that can sell for a price competitive with conventional heating and air conditioning installations.

However, the possibilities of a heat pump for domestic use are so great that much work is being done on all these factors. A fairly large number of heat pumps is installed in office buildings and commercial establishments, and a few in industry, and there are domestic heat installations in many parts of the country. The latter, in many cases, have been rigged up by the householder himself and, for those interested, there is a great deal of good performance information available. But the average householder does not want to have to do anything like this; and if a good domestic unit can be worked out at the proper price, especially one that does not require the use of water, the potentialities of the domestic heat pump are obvious.

* * *

**ACCEPTABLE substitute for natural gas may be available late in 1954 or early 1955 according to Capt. E. S. Pettyjohn, vice president and director of the Institute of Gas Technology. Reporting recently to a meeting of the Gas Institute he said that last year marked the first time that a conversion to gas has been accomplished without a solid or liquid residue resulting in the operation. This was performed by a new process of pressure hydrogasification which allowed the Gas Institute to produce a completely interchangeable natural gas substitute from natural gasoline with complete conversion of the gasoline to gas.**

* * *

DETERMINATION of policies respecting the development and utilization of our human resources must not become the private preserve of organized groups which are primarily and understandably concerned with protecting and advancing the interests of their members, declared James D. Zellerbach, Chairman of the National Manpower Council, in opening a five-day conference, called by the Council, on how to improve utilization of the country's scientific and professional manpower. Sixty-six leaders in the fields of engineering, medicine, education, science, industry, government, and the armed services from all over the United States took part in the Conference from October 7–11 at Arden House on Columbia University's Harriman Campus.

**BY 1975, there will be 193,000,000 people in the United States and they will be holding down 79,000,000 jobs, and gross national production will be $566,000,000,000, double that of 1950. But life will have become so complicated that it could all add up to nothing but frustration and inefficiency unless we learn to make things fit and to make things work through standardization of machines and parts, of blueprints and drawings, and of words and definitions.**

**This is the picture of the production future of this country that was word-painted in Toledo, O., by Roger E. Gay, president, American Standards Association, New York, and president of The Bristol Brass Corp., Bristol, Conn. He was addressing the 1953 fall conference of the Sixth District, National Association of Purchasing Agents.**

* * *

DR. WILLIAM D. COOLIDGE, former vice president and director of research for the General Electric Co., was honored on his 80th birthday at Cleveland by tributes from leaders of business and the scientific world, with Dr. Clyde Williams, Director of Batelle Memorial Institute, serving as chief speaker. Dr. Coolidge is the world-famous scientist whose discoveries have given us the modern lamp bulb, X-Ray tube and other electronic tubes, the art of powder metallurgy and industrial cutting tools. He is noted chiefly for his discovery in 1908 of a means of making a tough metal, tungsten, into an extremely pliable one that could be drawn into wire. That discovery made practical the use of tungsten as filaments in lamp bulbs and is chiefly responsible for their long life and efficiency. Later, he extended this new knowledge by developing an X-Ray tube of the type universally in use today.

* * *

**ORGANIZATION of a new manufacturers' association — the Institute of Environmental Equipment Manufacturers — has just been announced by Dr. George D. Wilkinson, General Manager. Institute headquarters will be at 30 Church St., New York, N. Y.**

**Environmental equipment simulates low temperatures, high temperatures, salt-spray, sand-storm, rain, altitude, etc. It is used: (1) for laboratory testing of equipment to be used by the military and (2) to determine effects of weather on such consumer items as plastics, automotive parts, washing machines, etc. Environmental equipment also is used in manufacturing processes — for example, to cool rubber so that it can be machined and to shrink metal parts for shrink fitting. This equipment simulates temperatures to −150F.**

**One of the Institute's most important functions will be to supply industry with technical data on environmental testing. Along this line, a library will be maintained, standards will be prepared in cooperation with the National Bureau of Standards, and technical bulletins will be disseminated both to industry and to educational and research organizations.**

THREE complete Westinghouse 75,000-kw thermal electric power plants, costing approximately $29,500,000, have been ordered by the Kyushu Electric Power Co., Inc., and the Kansai Electric Power Co., Inc. of Japan. First of their size ever exported from this country, the three units are part of a vast program now under way in Japan to expand the electric power facilities of that country. Two of the three units have been ordered by the Kansai Co. and will be installed in central Japan at Tanagawa Station near Osaka, second major city of the country. They will be combined by Kansai into a complete 150,000-kw steam power plant with two generating units of 75,000-kw each, designed to operate at high temperatures and pressures. The Kyushu plant will be identical in design to the Kansai unit, but will consist of a single unit of 75,000 kw.

* * *

**NEW METHOD of measuring chemical conversions which take place in pre-treatments used as paint bases for steel surfaces has been devised in the Research Division of New York University's College of Engineering. The new system is expected to aid greatly in assuring production control by controlling the solubility of paint bases, according to Dr. Max Kronstein, who supervises surface technology research. The organic coating applied over the base will become more durable if the chemical pre-treatment base can be made as insoluble as possible. The experiments point to a convenient and practical control method in the pre-treating of steel surfaces with metal-phosphate coatings. Applying the phosphate coatings before the paint, it is claimed, appreciably increases the bonding characteristics between the paint and the steel.**

* * *

ONE OF industry's newer devices, the mercury electric switch, has put on "overalls" for rough working conditions, a Safety Session of the Fall General Meeting of the AIEE was told. Mercury switches, which do a wide variety of jobs, ranging from protecting the housewife when she opens her electric washer to heavy industrial uses, may be cast into a solid block inside a metal can where working conditions are rough, according to Arthur L. Riche, vice president, Micro, a division of Minneapolis-Honeywell Regulator Co.

* * *

**E. W. SPANNHAKE, mechanical engineer, has been named Director of Engineering and Research for LeTourneau-Westinghouse Company, Peoria, Illinois. Mr. Spannhake was formerly associated with Barnes and Reinecke, Inc., of Chicago and before that with such companies as American Bosch, Alco and Lima-Hamilton.**

* * *

POWER FAN Manufacturers' Association was formed in October at a meeting at Atlantic City, N. J. Formerly the Propeller Fan Manufacturers' Association, the new organization is a consolidation with a group of twelve power roof ventilator manufacturers. Primary purpose of the Association is to establish accurate delivery ratings. The new association now has 34 members whose products cover axial fans, propeller fans, power roof ventilators, window kitchen and attic fans. Offices of the new Association are at 2159 Guardian Bldg., Detroit 26, Mich.

**IT IS NOT coincidence that General Electric Co. is spreading out its various factories in small towns away from the thickly populated centers of industry. Clarence H. Linder, G-E vice president of engineering has forecast that further expansion of the nation's growing industrial facilities to American small towns will be carried on. It is entirely impractical, he says, to continue our manufacture in a handful of key plants in as many cities. He says that, confident in the belief that agriculture and manufacture are the two basic activities of our economy, G-E believes they should know each other better and one of the best ways to bring that about is to put small manufacturing operations into an agricultural background.**

* * *

CENTER for holding and photo-duplicating foreign translations has been established by the National Science Foundation in the science division of the Library of Congress. Partial support for the project has been contributed by the U. S. Atomic Energy Commission. Establishment of the translations center is part of a foundation program to assist American scientists in keeping informed about current scientific progress in other countries. Full information about the new service can be obtained from Scientific Translations Center, Science Division, Library of Congress, Washington 25, D. C.

* * *

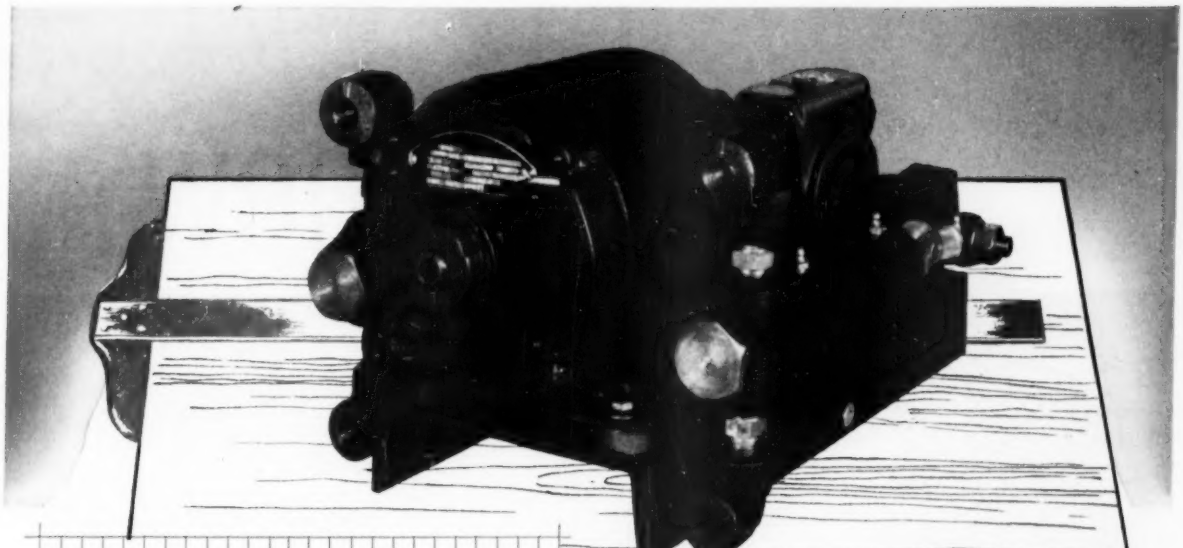
**COMBUSTION ENGINEERING, INC., has established a nuclear power division to be headed by David M. Schoenfeld, who will report to W. H. Armacost, vice president in charge of engineering. This step was taken primarily to give separate identification to an activity in which the company has been engaged for some time and to facilitate its expansion. Among other projects, as previously announced, the company is occupied with the supplying of major components for an atomic powered submarine, also developments in utilizing the heat generated in nuclear reactors for power production.**

* * *

BURNS AND ROE, INC., Engineers and Constructors, whose headquarters are in New York City, announce the formation of Burns and Roe of Michigan, Inc. with offices in the Book Building, Detroit 26, Michigan to serve more closely its practice in the Great Lakes region. Charles S. Lumley has been appointed Vice President and General Manager of the Michigan organization. Mr. Lumley received his engineering education in England, followed by post-graduate work at Columbia University. He is a Fellow of the AIEE, Charter Member of the Engineering Society of Detroit, member of the ASTM and the NSPE. He has been general manager of Roller-Smith Co., was associated with Smith, Hinchman & Grylls, Inc. as chief engineer and general manager of the industrial division and, more recently, was the executive vice president of H. E. Beyster & Associates, Inc.

* * *

**DR. P. W. BAKARIAN, expert on light metals, has been named plant manager of Cramet Inc., wholly owned subsidiary of Crane Co., which has a plant under construction at Chattanooga, Tenn. for the production of titanium sponge and ingots.**



# JOB ENGINEERED

# H-20 PUMP FOR DEPENDABLE LOW-COST SERVICE

For water treating services, and other applications that do not need the extremely high accuracy of Step-Valve liquid ends, Milton Roy offers the performance-proved H-20 Controlled Volume Pump.

This rugged pump has already gained wide acceptance in a variety of applications . . . in water treating installations, dry cleaning plants, bottling works . . . and as components of packaged steam boilers.

**CAPACITIES:** 3 to 12 gallons per hour in standard models.
**MODELS:** Simplex or Duplex (illustrated).
**DISCHARGE PRESSURES:** To 600 pounds per square inch.
**MATERIALS OF CONSTRUCTION:** Cast Iron and Stainless Steel.
**PRICE:** As low as $174.00 for cast iron construction, stainless steel trim, 300 psi discharge pressure, 6 gallons per hour maximum, ⅓ hp motor, single phase, 60 cycles, 115 volts, open.

Truly job-engineered, this dependable, low-cost H-20 pump includes such design features as double ball-checks on suction and discharge . . . spring-loaded packing that insures proper tension . . . construction for mounting any standard NEMA frame ¼ hp or ½ hp motor . . . simplicity in converting to duplex model.

H-20 is the latest product of Milton Roy . . . manufacturing engineers of controlled volume pumps and complete chemical feed systems for all industry.

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# new

# WIDER VISION

## for easier remote boiler water level readings

Yarway Remote Water Level Indicator is of the manometric type with automatic temperature compensation. Note new "wide vision" face See Yarway Bulletin WG-1823.

■ Vastly improved visibility of remote boiler water level readings can now be enjoyed by boiler plant operators.

The new "wide vision" face on Yarway Remote Liquid Level Indicators allows reading from the side as well as the front of the indicator.

Boiler water levels and other liquid levels can be checked from most any position in the control room or wherever the Yarway Indicator is installed.

Indicating mechanism is operated by the boiler water level itself, assuring instant, accurate readings. Indicating mechanism is never under pressure. There are no stuffing boxes.

Over 10,000 Yarway Remote Liquid Level Indicators are successfully used throughout industry—primarily for indicating boiler water levels, but also other liquid level applications, and for super-heater pressure differential indication aboard ship.

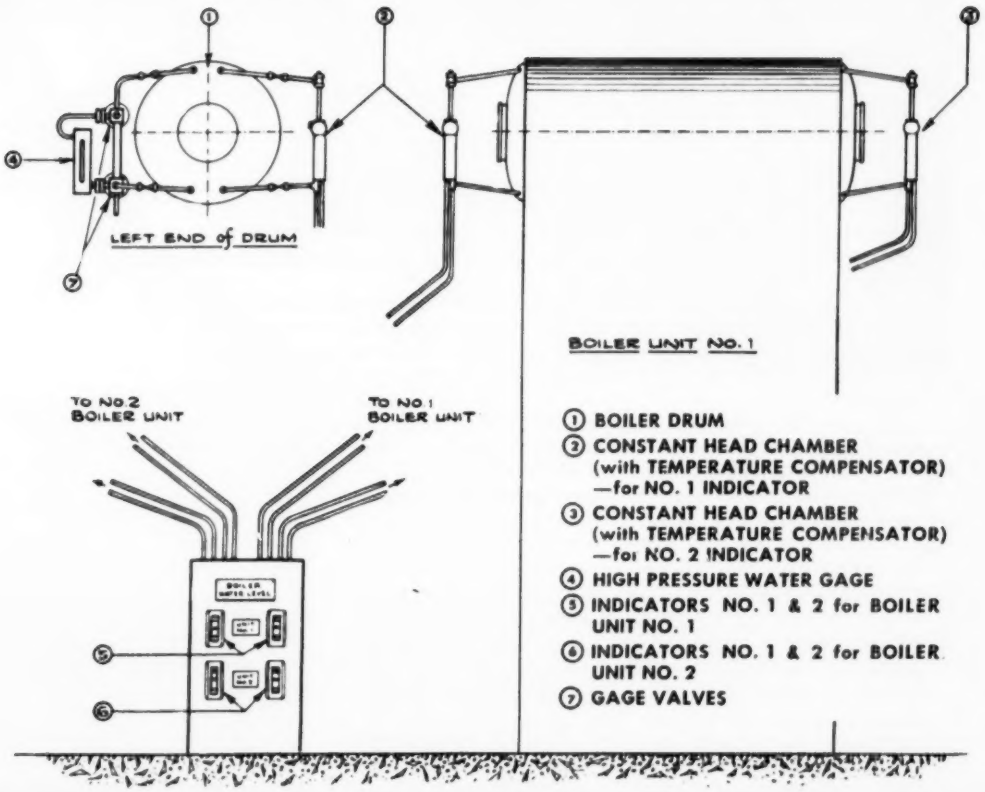
APPROVED MANOMETRIC TYPE

Yarway Remote Liquid Level Indicators are of the manometric type, with automatic temperature compensation, as approved for use under the new ruling of the A.S.M.E. Boiler Code Committee as covered in Code Case #1155, which permits the use of two remote indicators in place of one of the high pressure boiler water gages on boilers over 900 psi.

Additional information—write

**YARNALL-WARING COMPANY**
114 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

**Suggested installation of Yarway Remote Liquid Level Indicators and High Pressure Water Gages as now permitted by the A.S.M.E. Boiler Code.**


LEFT END of DRUM
BOILER UNIT NO. 1
TO NO 2 BOILER UNIT
TO NO 1 BOILER UNIT
① BOILER DRUM
② CONSTANT HEAD CHAMBER (with TEMPERATURE COMPENSATOR) —for NO. 1 INDICATOR
③ CONSTANT HEAD CHAMBER (with TEMPERATURE COMPENSATOR) —for NO. 2 INDICATOR
④ HIGH PRESSURE WATER GAGE
⑤ INDICATORS NO. 1 & 2 for BOILER UNIT NO. 1
⑥ INDICATORS NO. 1 & 2 for BOILER UNIT NO. 2
⑦ GAGE VALVES

**YARWAY® remote liquid level indicators**

For more data circle 505 on Post Card

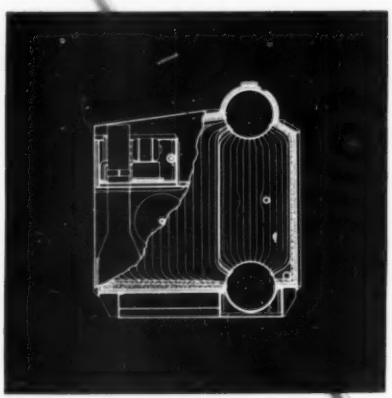
# Which C-E Boiler meets YOUR steam needs best?

These four C-E Boilers have been specifically designed to meet the requirements of a wide variety of plants. Collectively, they offer you a range of capacities from 4,000 to 350,000 pounds of steam per hour... pressures up to 1375 psi... temperatures to 960 F... arrangements for any fuel or method of firing.

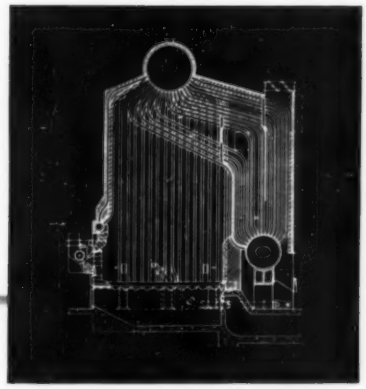
Two of these units, the VP and the VU-10, are fully standardized. Each of the other two has been standardized as far as is practical for its particular field of application. Thus, all four units reflect in purchase price minimum engineering costs made possible by maximum design standardization.

It's small wonder, then, that industries of all kinds have demonstrated widespread acceptance of C-E Industrial Boilers. The low steam costs and top reliability of these Combustion Boilers can be your guide, too, to the maximum return on your new boiler investment. B-703

**C-E Package Boiler — Type VP** The VP Boiler is designed to meet the demand for compact, standardized units in the medium pressure range. It is shipped completely shop-assembled, with firing equipment, fittings, and forced-draft fan. It is enclosed in a reinforced, welded steel, gas-tight casing. Arranged for pressure firing of oil or gas, the VP will burn either fuel exclusively or alternately. Designed for shipment by rail or truck, its width and height remain constant... variations are made in length only. Furnace is fully water-cooled, including burner wall, except in three smallest sizes. Large lower drum permits simple, symmetrical tube arrangement and greater water storage capacity.

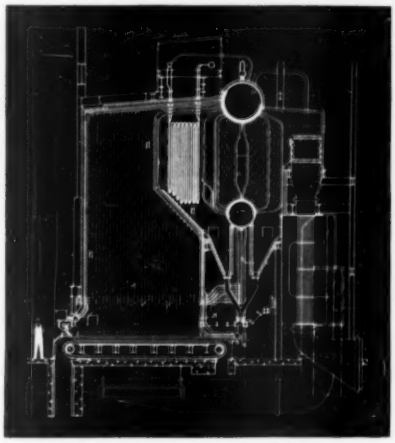


**Type VP Boiler** — from 4,000 to 30,000 lb steam per hr . . . pressure to 250 psi . . . available for either gas or oil firing . . . fully shop-assembled.



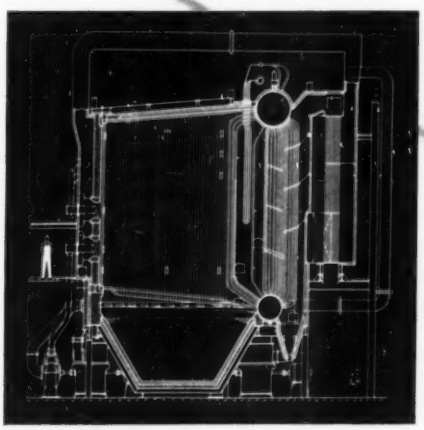
**C-E Vertical-Unit Boiler — Type VU-10** Like the Type VP Package Boiler, the VU-10 is designed for plants having a limited number of operating and maintenance personnel. It is designed for industrial load conditions and will operate efficiently over a wide range of output. The boiler is bottom supported and has no outside supporting steel. The same general cross-section arrangement of drums, boiler convection bank, and furnace wall cooling is used when firing oil, gas or coal. Coal firing may be with underfeed, spreader, or chain grate stokers.

**Type VU-10 Boiler** — From 10,000 to 60,000 lb steam per hr . . . pressure to 475 psi . . . superheat to 200 F . . . suitable for any type of fuel.



**C-E Vertical-Unit Boiler — Type VU-40** The VU-40 Boiler is a baffleless boiler designed for use with fuels having abrasive qualities in the flue dust. In a baffled boiler using these abrasive fuels, erosion is apt to occur. In the VU-40 Type Boiler, the eroding action of abrasives against boiler tubes and refractory is virtually eliminated. Like the VU-10 and VU-50, this unit is of symmetrical design, providing uniform gas flow and heat absorption across the full width of the boiler.

**Type VU-40 Boiler** — from 60,000 lb steam per hr up . . . pressure to 1375 psi . . . temperature to 960 F . . . for use with abrasive or high ash content fuel . . . indoor or outdoor type construction.



**C-E Vertical-Unit Boiler — Type VU-50** With the VU-50 Boiler, the average plant can achieve standards of performance closely approaching those of large central power stations. The basic design was originated by Combustion in 1925 and has been widely accepted among steam-power engineers everywhere. Because of its symmetrical design the VU-50 provides uniformity of gas flow, water level and steam release across the full width of the unit. It may be fired by pulverized coal as shown opposite or by any other fuel or method of firing. Heat recovery equipment may be added.

**Type VU-50 Boiler** — from 60,000 to 350,000 lb steam per hr . . . pressure to 1375 psi . . . temperature to 960 F . . . for any fuel or method of firing . . . indoor or outdoor type construction.

# COMBUSTION ENGINEERING, INC.

**Combustion Engineering Building • 200 Madison Ave., New York 16, N. Y.**

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

**For more data circle 506 on Post Card**

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •

# Simplified Control and Shut-off of Volume and Pressure

The underground application shows a 50-pound R-S Valve with gear reducer, lubricating lines and operating nut which is hand operated with a wrench. Only a few turns of the wrench are required to open or close the valve.

Practically every R-S Valve installation, particularly when automatically controlled, provides useful experience that can be applied in other industries although they may be far apart in classification. It is this accumulation of engineering experience coupled with unexcelled production facilities that can be so helpful to you.

Call the R-S representative at the inception of your application. Benefit by his research and engineering experience in the simplified control and shut-off of volume and pressure.

S. MORGAN SMITH Company • YORK, PA.

MANUFACTURERS OF

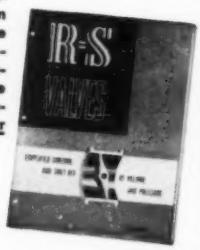
HYDRAULIC TURBINES-VALVES

REPRESENTATIVES IN PRINCIPAL CITIES

No. 850—Ten-inch, 300-pound valve equipped with 18-8 shafts, hastelloy bushings, stick lubricators and isolating valves, diaphragm top with handjack and positioner. Installed for the flow control of sour crude petroleum.

No. 801—Three-inch, 125-pound bronze screwed end valve with handlever control and locking device. There is a size and type of R-S Valve for any industry or process.

Catalog No. 20 describes R-S Valves in detail—types, prime movers, applications and specifications. Contains more than 150 illustrations. Write for your copy.

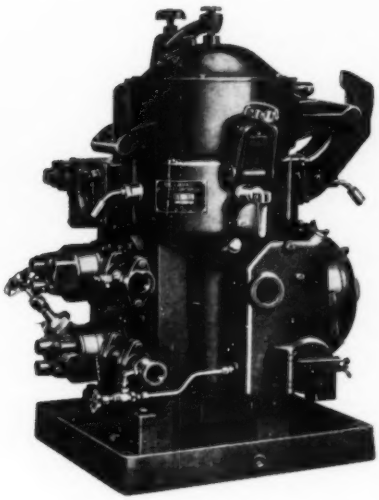



For more data circle 307 on Post Card

**NO GETTING AROUND IT!**

# YOU CAN'T SIDESTEP TROUBLE BUT YOU CAN PREVENT IT!

"Avoiding" trouble by hoping it won't happen to you can be costly. Better to ***prevent*** serious shutdowns by ***protecting*** your power unit from both of the causes of oil contamination—dirt and water. The comparatively modest investment represented by the cost of a De Laval centrifuge is far outweighed by the cost of even one serious shutdown.



De Laval Oil Purifiers apply centrifugal force in the most efficient manner, completely removing all water, dirt or sludge. They keep the lubricant both clean and dry. The double protection is vital, for water is often as serious a source of contamination as dirt.

De Laval Oil Purifiers do not remove oil-soluble additives — action within the centrifuge is entirely mechanical.

**DE LAVAL**

**THE DE LAVAL SEPARATOR COMPANY**
Chicago POUGHKEEPSIE, N.Y. San Francisco

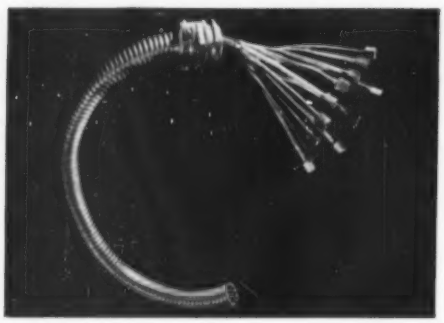
**FOR MORE DEPENDABLE POWER PRODUCTION**

For more data circle 516 on Post Card

## For the new pneumatic instrumentation

# Cabled Tube

The recent tremendous increase in the use of tube instead of wires for instrumentation and control purposes has led to an important new development—cabled tube. This is an armored group of long tubes twisted together to permit bending without distortion. An insulating tape is wrapped over the bundle of tubes to prevent electrolytic action. Then interlocking, flexible galvanized steel armor is applied, like BX. This protects the tubes from injury during shipment, storage, installation, and in service. Standard fittings, boxes and cabinets can be used for junction boxes and terminations. To make it possible to readily identify each tube, one tube in each layer is colored; the position of each tube in each layer in relation to the coded tube



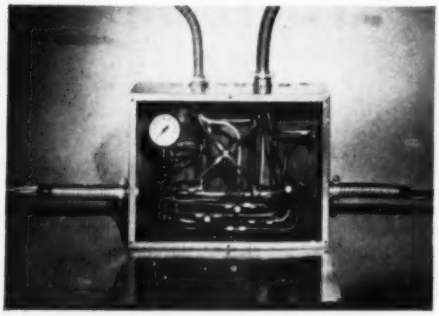
remains the same throughout the length of the cable.

The tubes usually are copper, but aluminum tubes can be used for special purposes. For unusually corrosive situations, a plastic outer sheath can be applied. As many as 19 tubes, ¼" OD, can be cabled, and supplied in lengths up to 1,000 ft.

Showing the construction of Crescent Armored Multitube, made by Crescent Insulated Wire and Cable Co., Trenton 5, N. J., which will supply further information on request.

For more data circle 543 on Post Card

Since the tubes carry not electricity but air, nitrogen, helium, or a fluid, they are especially attractive in potentially explosive locations, as in refineries and chemical plants. Utilities are also turning decisively to this new cable, while automatic process control (automation) is a rising application.



Revere, as a supplier of tube for this purpose, calls this cabled tube development to your attention as a matter of general and perhaps specific interest. See Revere for copper, aluminum and brass tube and pipe, electric welded steel tube, and lockseam tube. Call the nearest Sales Office.

**REVERE**

**COPPER AND BRASS INCORPORATED**

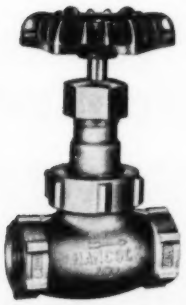
*Founded by Paul Revere in 1801*

230 Park Avenue, New York 17, New York

• • •

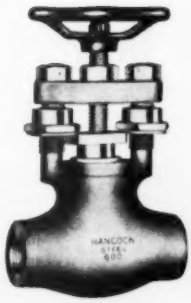
*Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere*

**SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS**



150#, 200# and 300# Bronze Globe, Angle and Check Valves

800# Steel Gate Weldvalves



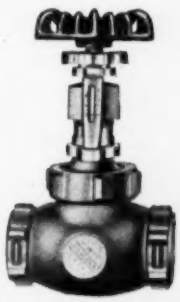
600# Steel Globe and Angle Weldvalves

1500# and 2500# Steel Globe and Angle Weldvalves

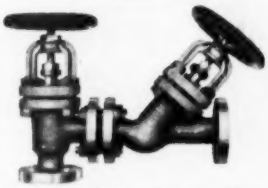
*there's a*

# HANCOCK VALVE

## FOR YOUR TOUGHEST SERVICE REQUIREMENTS



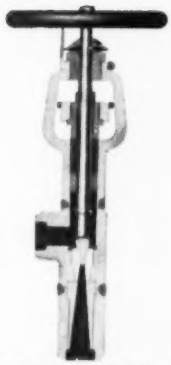
150# and 300# Bronze and 600# Steel "Flocontrol" Valves



300#, 600#, 1500# and 2500# Boiler Blow-Off Valves

Illustrated are some of the many fine Hancock Valves that contribute substantially to the high efficiency of plant operation and the low cost of valve maintenance. By anticipating the changing needs of expanding industry, Hancock has — since 1877 — pioneered the development of many different types of valves. Today, the outstanding quality and superior performance of Hancock Valves continue to surpass practically every job requirement, regardless of the demands of service. Yet, despite their long, trouble-free life, Hancock Valves cost no more than ordinary valves.

**When Hancocks go in, valve costs go down**



600# through 1500# Hi-Pressure Drop Weldvalves

300# and 600# Cast Steel Globe, Angle and Check Valves

**FAST SERVICE IS YOURS** through your nearby Industrial Supply Distributor. He stocks a wide selection of Hancock Valves to meet the diverse requirements of all industry. You can rely on his recommendations to help you obtain the best valves for your applications.

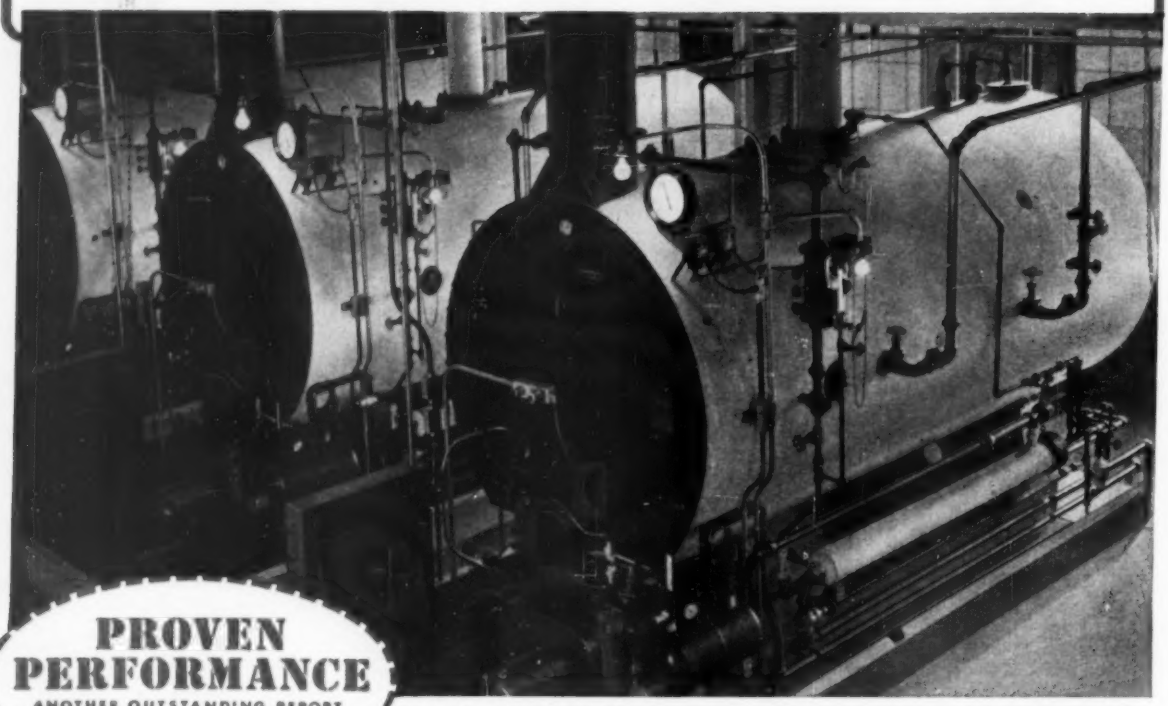
# HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

**For more data circle 510 on Post Card**

# Cleaver-Brooks boilers save $25,000 per year for Hoosac Mills...pay for themselves in 2 years' time!



**PROVEN PERFORMANCE**

ANOTHER OUTSTANDING REPORT FROM A CLEAVER-BROOKS OWNER

*After installation and starting service was completed, a check was made on boiler output. Tests indicated efficiency exceeded the guaranteed 80%. After eight months' operation without tube cleaning, stack temperature showed no noticeable gain, indicating high efficiency had been maintained. Planned and installed by Frank I. Rounds Co., Newton Highland, Mass.*

INSTALLING 3 Cleaver-Brooks self-contained boilers at Hoosac Textile Mills, New Bedford Division, was a major step in ending boiler worries. Hoosac can count on yearly savings of $25,000, and they're set up for future expansion as well.

Before deciding what type of boilers to install for replacing old, hand-fired boilers, Hoosac carefully considered these factors:

1. **Efficiency of steam generation** — the cost for supplying 12,000 lbs. of steam required each hour at peak capacity for heating and processing.
2. **Saving labor costs** — through safe, automatic operation.
3. **Cleanliness** — important to textile manufacture.

A study of past performance and prominence of similar units in the industry — showed that Cleaver-Brooks self-contained boilers would fill the bill.

Guaranteed 80% thermal efficiency was one of many influencing factors in selecting the 3 Cleaver-Brooks 150 hp. boilers. Even with loads as low as 30% of rating, these boilers operate with a flat 80% efficiency. (Hoosac operates their plant over widely fluctuating loads, particularly in summer.)

That they attained their objectives is borne out by these results — *results which showed the boilers paid for themselves in 2 years' time.*

1. **$15,000 savings in fuel** — fuel cost studies showed 275,000 gals. of oil at 5½¢ per gal. provide steam for a year's operation. Same steam formerly required 2,000 long tons of coal at $15.00 per ton.
2. **$10,000 savings in labor costs** — fully automatic operation minimized boiler maintenance. Personnel were then available for productive plant work.
3. **Cleanliness** — modern boiler room proved more efficient than previous cluttered arrangement. Hand firing, removal and disposal of fly-ash was eliminated.

In addition to these substantial savings, the installation provided for economical future plant expansion. At present, boiler operation is rotated so all three periodically receive the same service and maintenance.

Cleaver-Brooks boilers are showing similar savings in many other businesses. Investigate — write for Catalog AD-100 and complete information on standard size oil, gas, combination oil/gas fired Cleaver-Brooks boilers, 15 to 500 hp., 15 to 250 psi.

CLEAVER-BROOKS COMPANY
Dept. P-311 E. Keefe Ave.,
Milwaukee 12, Wis., U.S.A.

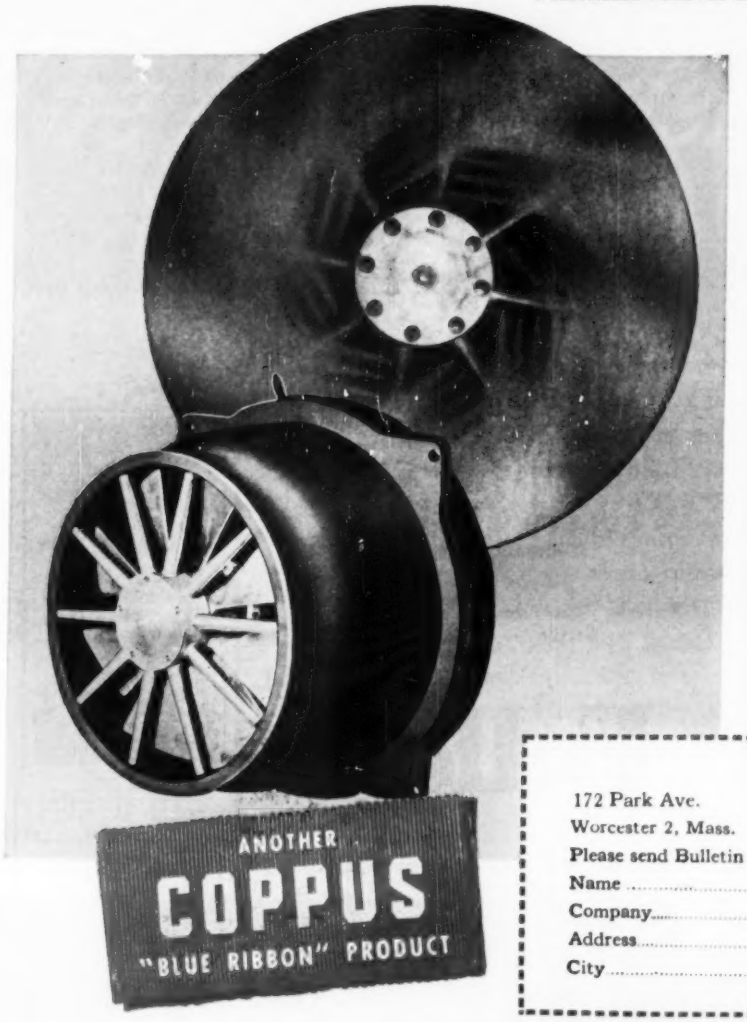
**Cleaver-Brooks**

ORIGINATORS OF THE SELF-CONTAINED BOILER

Steam Boilers • Oil and Bitumin Tank Car Heaters • Distillation Equipment Oil and Gas Fired Conversion Burners

**For more data circle 553 on Post Card**

# You get MORE CAPACITY with a FANMIX BURNER




## Increase Boiler Ratings On Present Or Planned Equipment

In all types of Coppus-Dennis FANMIX Burners — straight gas or combination gas-oil — we utilize the energy of the fuel under pressure to drive the burner fan and deliver air in the proper proportion to the fuel flow. This exclusive "pinwheel action" *mechanically* mixes fuel and air in exactly the right proportions for truly radiant, non-luminous heat.

The result is uniform temperature everywhere in the combustion chamber — no drifting "hot spots" — and complete combustion under all conditions. That's why you can release more heat into your present furnace — why in new installations you get more heat into smaller furnace space.

### FANMIX Saves On Both Old and New Installations

FANMIX can easily be operated with your present furnace and stack, requiring only minor changes in other equipment. Or if you're planning on new boilers, remember that FANMIX relieves the furnace from the burden of mixing, creates its own forced draft and takes smaller pipe sizes. Which means you can plan on reduced combustion space, less stack, no forced draft equipment and lower installation costs all around.

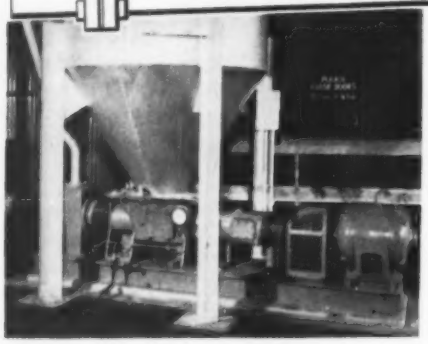
### Get the Whole Story

Coppus engineers FANMIX Burners to meet individual requirements, providing complete control over heat pattern and combustion . . . Learn more about how "pinwheel action" can step up *your* boiler performance to peak efficiency and economy — as it is doing throughout industry. Send for Bulletin 410-6. Coppus Engineering Corp., Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG, and MINING CATALOGS.

172 Park Ave.
Worcester 2, Mass.
Please send Bulletin 410-6 to:
Name .....
Company.....
Address .....
City .....Zone .....State.....

For more data circle 512 on Post Card

# fly-ash handling with fuller-kinyon system



Fuller screw feeder, discharging fly ash from Allen-Sherman-Hoff evacuating system.

at

## DUQUESNE LIGHT COMPANY
### ELRAMA STATION

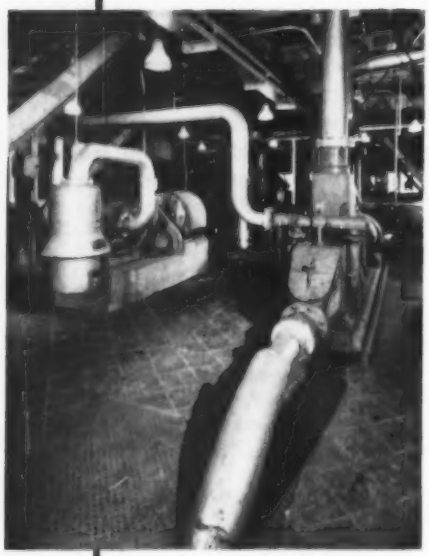
## SAFE • CLEAN • EFFICIENT CONVEYING

Duquesne Light Company, Pittsburgh, Pa., Elrama Station, takes full advantage of the efficiency of the Fuller-Kinyon Conveying System for disposal of its dry fly ash from boilers.

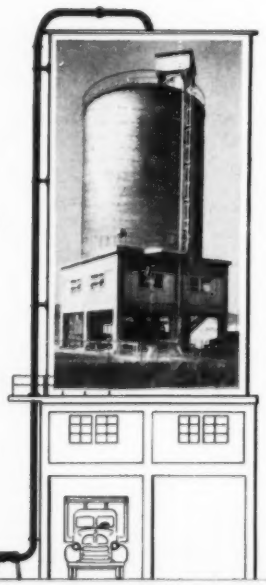
An Allen-Sherman-Hoff evacuating system discharges the fly ash to a Fuller screw feeder which, in turn, delivers the material, through a vertical pipe leading downwardly, approximately 100 feet, to a Fuller-Kinyon Pump on the ground floor of the boiler house.

The Fuller-Kinyon System conveys, underground, to a storage and loading silo in the yard, a distance of approximately 800 feet, at rate of 25 tons an hour. A Fuller Rotary Single-stage Compressor furnishes 763 c. f. m. of air at 30-lb. pressure to the Fuller-Kinyon Pump, through a direct-connected air line. Air, where and when needed, at the proper pressure to do the work required most efficiently and economically.

Air-conveying of dry, pulverized materials has had specialized engineering treatment at Fuller for twenty-seven years. Why not take advantage of this experience the next time you have a conveying problem? We'll be glad to work with you and give you the benefit of this experience.



Fuller-Kinyon Pump, right, conveying to storage. Fuller Rotary Single-stage Compressor, left, furnishes air for conveying.



**FULLER COMPANY**
**Catasauqua, Pa.**

*Branch Offices*

Chicago • San Francisco • Los Angeles
Seattle • Birmingham

# Fuller

**DRY MATERIAL CONVEYING SYSTEMS AND COOLERS—COMPRESSORS AND VACUUM PUMPS—FEEDERS AND ASSOCIATED EQUIPMENT**

P-151
2173

**For more data circle 513 on Post Card**

# The Big Header

*Also for U.S. Steel's Youngstown, Ohio Plant*

Blaw-Knox is also furnishing and installing complete piping for an addition to the power facilities and erecting the new 18,750 KVA turbo-generator with its various auxiliaries.

MANY a big header has been fabricated at Blaw-Knox, but "The Big Header" for U.S. Steel's Youngstown, Ohio plant tops them all! With an over-all length of 36½′ and weighing 10½ tons it will distribute steam from two boilers at 900° F and 950 psi to the 18,750 KVA turbo-generator and auxiliaries. For the heating system and other equipment a reducing station will step steam temperature and pressure down to 600° F and 280 psi. Piping to the turbo-generator is Chrome-Moly Alloy Steel 14″ in diameter with a wall thickness of 0.937″. Shop prefabrication by the Blaw-Knox Power Piping and Sprinkler Division gave far closer control over the finished product than is possible in field fabrication. We will be glad to discuss our ability to cope with any piping problem.

**BLAW-KNOX**

**BLAW-KNOX COMPANY**
**POWER PIPING AND SPRINKLER DIVISION**
Pittsburgh 33
Pennsylvania

# *Could You Use* SAVINGS *Like These?*

**40% less**
**Fuel Consumption**
**50% more**
**Boiler Capacity**

## Bailey Meters and Controls Insure Savings at Kerr Bleaching & Finishing Works, Concord, N. C.

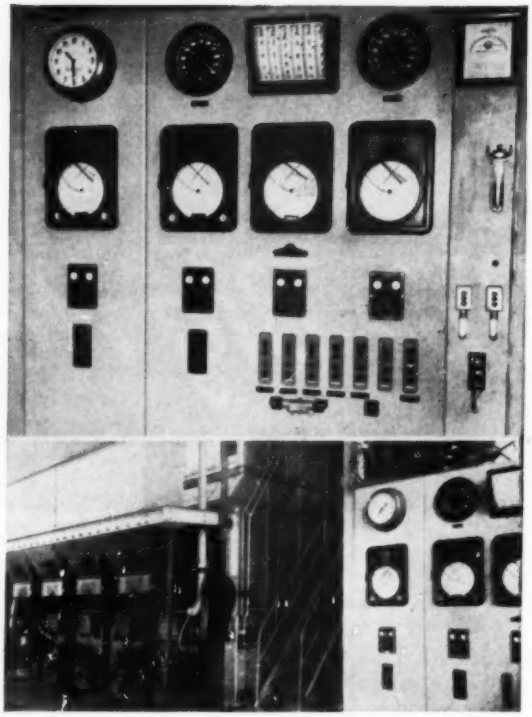
The key to complete returns on any investment in new power equipment is a fully co-ordinated system of meters and controls. It's the old story, the tail that wags the dog—careful attention to this comparatively minor part of the over-all installation cost can mean the difference between profit and loss in operation.

Here's where Kerr Bleaching & Finishing Works has cut operating costs—by installing *co-ordinated* Bailey Meters and Controls. The installation includes Bailey Meter Combustion Control, and Bailey Two-element Feed Water Control.

Such a co-ordinated system is an important plus for Bailey customers. Nowhere else can you buy such a complete range of equipment, selected without bias to do the best job for you. Nowhere else can you find such expert engineering service, immediately available through conveniently located direct sales and service representation. May we help you?

Call our local branch office or write for Bulletin 15-H.

A-113



Control panel, showing completely co-ordinated Bailey Meters and Controls at Kerr Bleaching and Finishing Works, Concord, N. C.

**BAILEY METER COMPANY**

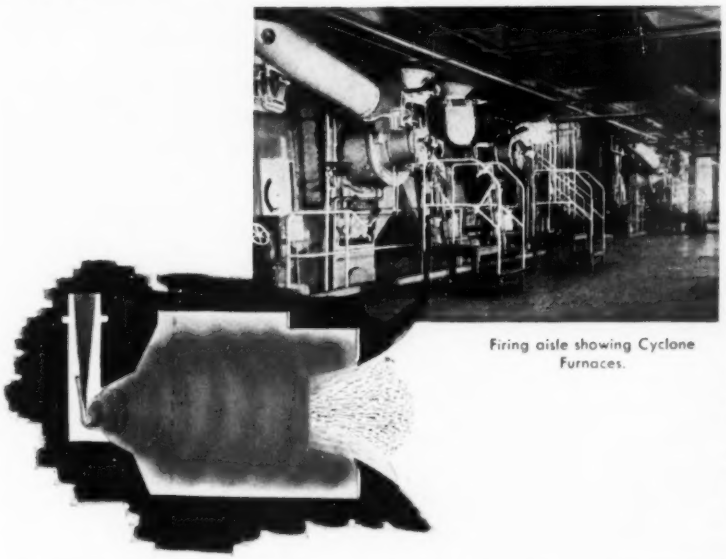
1040 IVANHOE ROAD
CLEVELAND 10, OHIO

**Controls** *for Steam Plants*
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

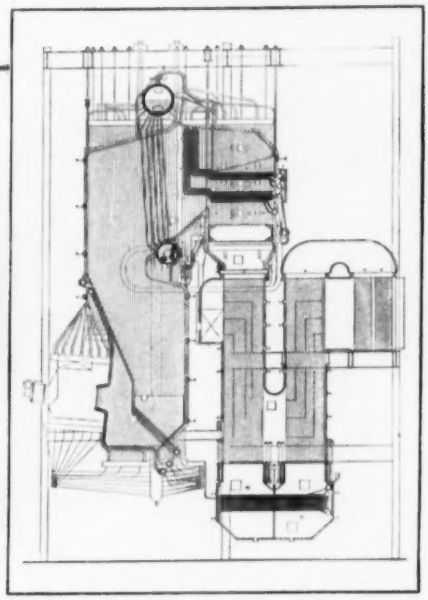
For more data circle 515 on Post Card

# More B&W Pressurized Cyclone Furnace Boilers on the Line

## LARGE CHEMICAL PLANT INSTALLS 4TH and 5TH CYCLONE UNITS



Firing aisle showing Cyclone Furnaces.



B&W Cyclone-Fired Radiant Boiler for a leading chemical manufacturer. Four units of this design are installed in one power plant. A similar unit is in operation at another of the company's plants. Each boiler normally generates 400,000 pounds of steam per hour with superheater outlet conditions of 1250 psi, 830 F. The design pressure is 1400 psi.

Having pioneered Cyclone Furnace firing for industrial steam plants, a large chemical manufacturer has recently placed its fourth and fifth Cyclone-fired boilers into operation. The first pressurized Cyclone-fired boiler ever built has been in successful continuous operation at one of this company's plants since February 1949.

### ELIMINATION OF FLY ASH PROBLEM

Low fly-ash discharge to the stack, without the use of precipitators, was a prime consideration in the original selection of Cyclone Furnaces for the first three units back in 1946. Most of the coal-ash is converted to liquid slag which is removed through the slag tank, and can be disposed of readily. Thus, some of the most difficult problems in power-plant operation — preventing heavy stack discharge and eliminating the handling of large amounts of useless fly ash—are overcome. But, in addition to solving these problems, a whole host of other benefits have also been realized, and Cyclone Furnaces were thus the logical choice for the firm's two new units.

### SIMPLIFICATION OF COAL BURNING EQUIPMENT

Simplification of the entire process of supplying and burning the coal is an important asset of Cyclone Furnace firing. It reduces maintenance costs, makes operation easier, and improves availability. This is because pulverizers, with their drives, fans, ducts, and burners are not needed, since the Cyclone Furnace uses coal which is merely crushed, instead of pulverized. This also increases safety and lends itself readily to "push-button" operation.

### GREATER FUEL EFFICIENCY — WIDE COAL RANGE

Greater firing efficiency results from the great turbulence and high temperatures in the Cyclone Furnace. Carbon loss is practically eliminated. In addition, excess combustion air is reduced, bringing a corresponding reduction in heat lost to the stack.

A wide range of coals is burned in the Cyclones. Piney Fork coal is the designed fuel for this plant, but coals of many different varieties have been burned successfully.

### PRESSURE-FIRING — NO INDUCED DRAFT FAN

Pressure-firing without induced draft fans is another pioneering achievement of this chemical company in its five Cyclone-fired units. Since the first boiler was placed on the line nearly five years ago, pressure-firing has contributed to smoother operation with reduction in fuel consumption. Having only forced draft fans on the unit eases the operator's tasks, simplifies controls, and saves considerable auxiliary power.

B&W's experience with Cyclone Furnaces, Pressure Firing, and so many other cost-saving engineering advances, is at your disposal when your next plant is being designed.

The Babcock & Wilcox Co., 161 East 42nd St., New York 17, N. Y.

BABCOCK & WILCOX

BOILER DIVISION

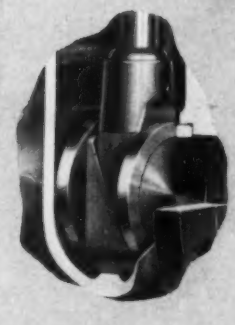
G-618

For more data circle 508 on Post Card

DARLING VALVES

# 2 VALVE PRINCIPLES

## that save money for DARLING Cast Steel Valve users!



**1** ***Darling Fully Revolving Double Disc, Parallel Seat Gate Valve.*** **Just four simple working parts . . . two interchangeable, no-pocket discs and two husky wedges. Maintenance is easier, assembly is foolproof, and tight seating is assured.**

**2** ***Darling Slotted Wedge Type Gate Valve.*** **Notice the unique center slot which permits wedge to seat under compression and adjust to valve seats as valve body expands and contracts.**

## Select the DARLING Valve to meet your specific needs

WHETHER you select the fully revolving double disc, parallel seat type . . . or the slotted double grooved wedge type . . . you'll have a Darling gate valve with outstanding features that are minimizing down time and cutting maintenance costs on job after job.

**Check cutaway view No. 1.** This famous Darling self-adjusting, revolving disc parallel seat gate valve is rated by users as the most trouble-free, best performing gate valve obtainable. Its simple, efficient design assures *automatic* compensation for valve body distortion. In addition, wear on valve parts is *uniform*, which means much longer service life.

**Now take a close look at cutaway view No. 2.** This Darling valve will do everything that an ordinary solid wedge valve can do . . . *and more.* The wedge is slotted to assure better seating under valve body expansion and contraction. Tight closure and easy operation are assured, and there is far less wear on wedge faces and seats. *Also,* the *double* grooves, with *twin* guide ribs in the valve body, provide twice the usual bearing area. Canting of wedge caused by line pressure is thus eliminated, preventing damage to the downstream seat.

You'll be wise to get all the facts about these two types of money-saving Darling cast steel gate valves before you decide on any valve. Write today for general literature, or request information on your specific valve needs.

**NOTE:** Darling gate valves are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.

**DARLING VALVE & MANUFACTURING CO.**

**Williamsport 19, Pa.**

*Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario*

**For more data circle 517 on Post Card**

TRADE PAPER EDITION
Published by
SCHUTTE and KOERTING Company

ENGINEERING News

JET APPARATUS • HEAT TRANSFER EQUIPMENT • STRAINERS • CONDENSERS AND VACUUM PUMPS • OIL BURNING EQUIPMENT

# NEW STRAINER FOR HIGH PRESSURE STEAM AND BOILER FEED SERVICE FEATURES FORGED BODY AND "PRESSURE SEAL" JOINT*

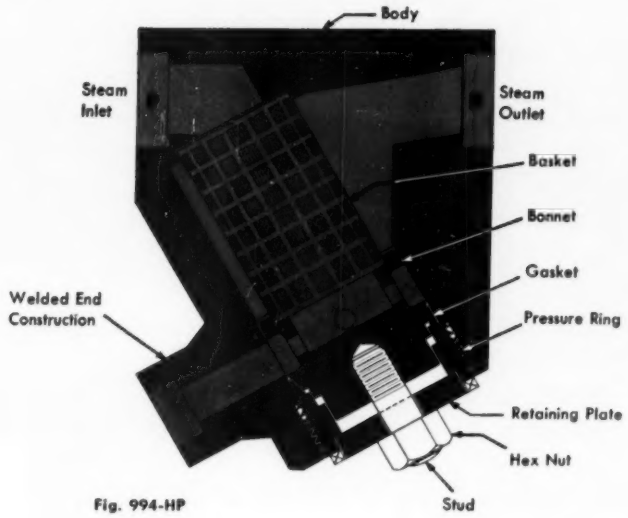


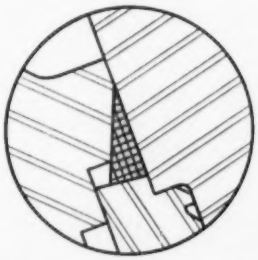

Fig. 994-HP

After several years of field testing in selected high pressure power plants, SK now announces the general availability of a new "Y" Type Strainer for steam and boiler feed pressures from 900 lbs. up.

The strainer, designated an *SK Fig. 994-HP Strainer*, features a forged steel or alloy body and "pressure seal" bonnet construction. The "pressure seal" joint, see Fig. 994-HP and note above, eliminates the excessive bulkiness of a flanged, bolted cover which, at higher temperatures and pressures, necessitates the use of large studs and nuts and unnecessarily large over-all design. As shown, the "pressure seal" design is compact with minimum face to face dimensions.

The basket is rolled from perforated or drilled plate which, when required, serves as backing for a fine mesh screen. The blow down connection has been brought through the side of the strainer wall. This design feature means that no piping need be broken when removing the cover and strainer basket from the body for maintenance, checking, or replacement. This factor is particularly advantageous at high pressures and temperatures where pipe joints are usually welded.

SK Fig. 994-HP Strainers are made in any size required by the application. At present, no other literature is available, however, if you have any questions, write to us at the address below and our engineers will reply at once.

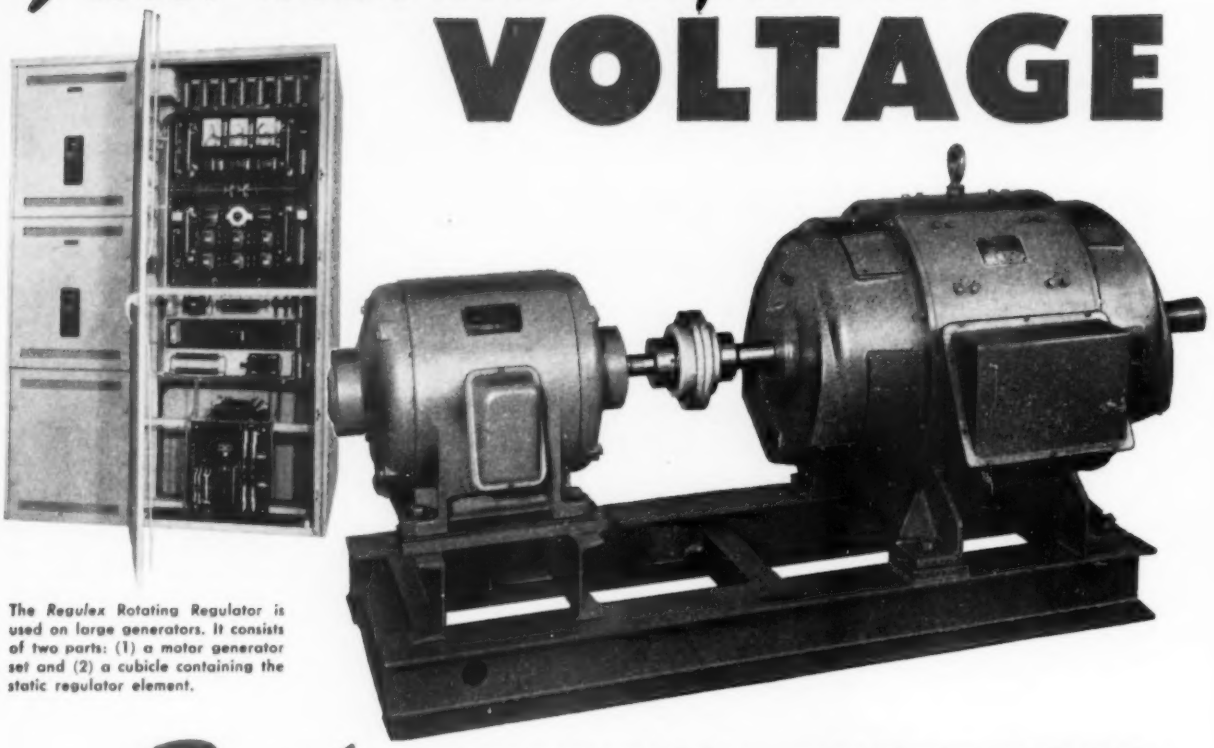


***NOTE:** Schutte and Koerting Company is one of the pioneers in the development of pressure seal joint construction in the United States having first experimented with this design in 1938. As shown in Fig. A (detail drawing of the "pressure seal" gasket) practical experience and research have resulted in a successful design wherein the gasket angle is relatively narrow and the gasket has been completely plated with a metal coating. The sharp gasket angle is of particular importance in small diameter pressure seal joints where the ratio of linear circumferential length of the gasket tip, which must be expanded, to the pressure area of the small diameter cover, is relatively high. The thin metal coating material is of a non-corrosive "lubricating" nature and is satisfactory for high temperature service while being soft enough to deform, under pressure, and fill minute irregularities in the body bore and cover gasket face. The base metal of the ring, under the coating, meets rigid specifications of dead soft anneal and dimensional tolerances. Note, also, that the body counterbore diameter is increased just below the gasket. This eliminates the necessity for drawing the gasket out through a long, close diameter bore and makes disassembly easy.

SCHUTTE and KOERTING Company
*Manufacturing Engineers*
54 STATE ROAD
CORNWELLS HEIGHTS
BUCKS COUNTY, PA.
Representatives in Principal Cities

For more data circle 518 on Post Card

# *Fast, accurate, dependable* VOLTAGE



The *Regulex* Rotating Regulator is used on large generators. It consists of two parts: (1) a motor generator set and (2) a cubicle containing the static regulator element.

## *Regulex* ROTATING REGULATOR

★ **Maximum Productivity from New Generators**
★ **New Efficiency from Present Installations**

*Regulex* voltage regulators incorporating automatic minimum excitation permit generator operation close to the stability limit . . . much closer than manual operation allows. The sensitivity and exceptional response of the *Regulex* voltage regulator and associated equipment establish and maintain a safe ratio between generator load and field current . . . increase operating limits at any given power factor load . . . assure the proper reactive kva division. The *Regulex* voltage regulator does not require multiple special fields in the exciter — may be applied to any standard shunt machine. Write for literature. A-4189

## *New* Magnetic and Electronic Amplifiers

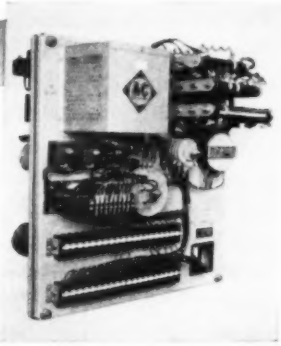
### Versatile "Tools" Used in Solving Your Particular Voltage Regulation Problem

For special industrial and military regulating systems, added flexibility is obtained by using magnetic and electronic amplifiers. These components *supplement* but do not replace the *Regulex* rotating amplifier in most applications.

The magnetic amplifier is used primarily where reversible output from the amplifier is not required. Special exciter design is eliminated in such applications. The shock-proof characteristics of the magnetic amplifier make it particularly adaptable to military voltage control.

Electronic amplifiers are used only on applications that require exceptionally high sensitivity.

Applications of magnetic and electronic amplifiers for purposes other than voltage control include speed, current, and tension regulation.



Voltage regulator with current limiting device. Used for control of static rectified dc power supply.

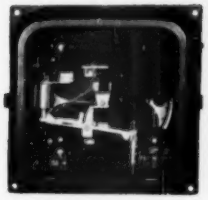
# REGULATION
## *For* ANY *Size Generator*

## *Rocking Contact* VOLTAGE REGULATORS

### *dc Applications*

The Type VD Regulator has been designed to meet the demands of voltage or current characteristics of dc machine operation. Resistors are cut in and out of the exciter shunt field by the *Rocking Contact* sector. No sluggish, time wasting relays.

No vibrating or sliding contacts to wear out. A small movement of the *Rocking Contact* sector over a curved commutator covers the entire regulating range. Type VD regulators are available for all dc generators. Write for Bulletin 14B6137A.



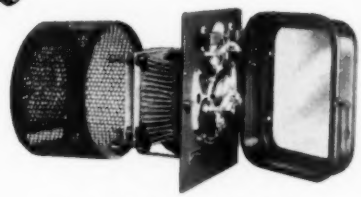
VD-2 Regulator for dc generators from 10 kw at 80 rpm to 200 kw at 3600 rpm

### *ac Applications*

Types V-00 and 221 Regulators

#### FOR SMALL GENERATORS

*Rocking Contact* Voltage Regulators are available in two types for use on small ac generators with direct-connected exciters — Type V-00 for generators to 157 kva maximum at 3600 rpm; Type 221 for generators to 438 kva maximum at 3600 rpm. These regulators can be modified for temperature compensation, shock mounting or other special requirements. Bulletin 14B6143A gives details.



Types A, B, & C Regulators

#### FOR MEDIUM SIZE GENERATORS

Types A, B, and C Regulators differ only in kva range.

**Type A Regulator**— for ac generators, 125 kva at 257 rpm to 1750 kva at 3600 rpm.

**Type B Regulator**— for ac generators, 1000 kva at 257 rpm to 6250 kva at 3600 rpm.

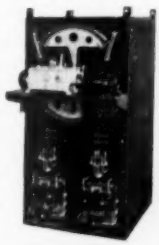
**Type C Regulator**— for ac generators from 3125 kva at 257 rpm to 25,000 kva at 3600 rpm.

All have guaranteed sensitivity of plus or minus 0.5%. Write for Bulletin 14B6035B.

#### FOR LARGE GENERATORS

Type J *Rocking Contact* Regulators are of the exciter field rheostatic type designed for the control of large synchronous machines. This regulator consists of two parts: (1) a voltage sensitive torque motor control element for panel mounting; (2) a motor-operated exciter rheostat with high speed field forcing contactors. Write for Bulletin 14B6015A.

Type J Element



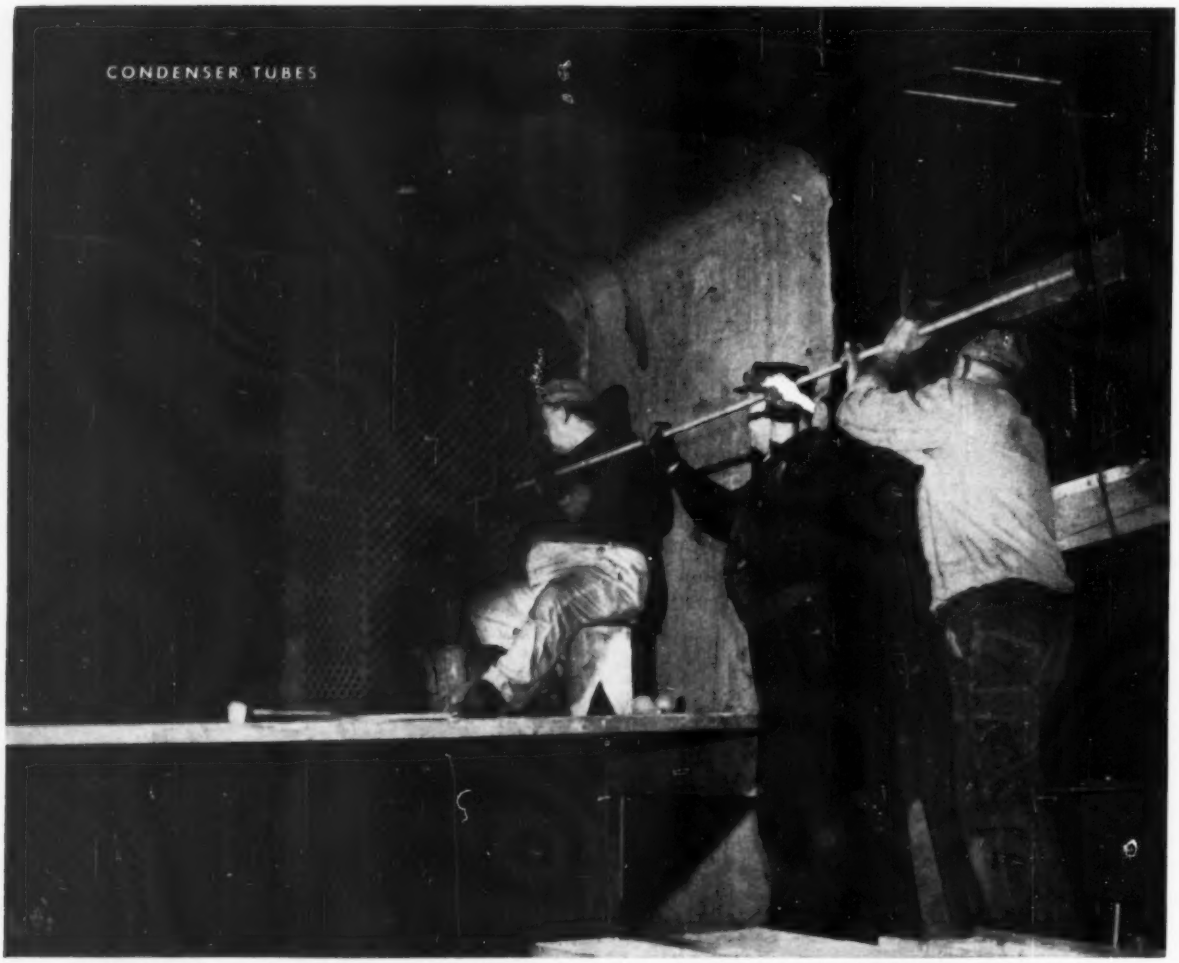
Motor-Operated Rheostat

*Regulex and Rocking Contact are Allis-Chalmers trademarks.*

# ALLIS-CHALMERS

**Milwaukee 1, Wisconsin**

For more data circle 519 on Post Card




**HERE'S ONE** of more than 6260 ANACONDA Ambraloy-927* Tubes going into Consolidated Edison's new condenser.

# Con Edison chooses Aluminum Brass for condenser tubes in new power plant

The Consolidated Edison Company's new power plant in Astoria, N. Y., will house 6 generating units. Unit #2, having a 160,000-kw generator, will be put on the line in the Spring of 1954. The condenser serving this unit has cooling surface area of 105,000 sq. ft. Tubes—15,450 of them—are Aluminum Brass, ¾" O.D., #18BWG, 30 ft. long. About half were supplied by Anaconda.

**LOCATED IN ASTORIA, QUEENS,** on the East River, Con Edison's new plant will mean better-than-ever electrical service for New York City.

ANACONDA Ambraloy-927* (aluminum brass) is one of the most durable tube alloys available at a moderate cost. It gives excellent service in both clean and polluted sea water and has largely replaced Admiralty along the U. S. seacoast. It is used not only in main condensers, but also in auxiliary coolers for lubricating oil, transformer oil, hydrogen and air.

Anaconda supplies Con Edison — which insists upon the best equipment available — with condenser tubes and tube sheets for many of their power plants. Whatever alloy best fits *your* operating needs, choose it from the extensive line of ANACONDA Alloys for tube and tube sheets. Our Technical Department will be glad to analyze your tube performance problems at no cost. Free Publication B-2, "ANACONDA Tubes and Plates for Condensers and Heat Exchangers," will be sent on request. Write: *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.* 53112

*U.S. Patent No. 2,003,685 (ORIG.)

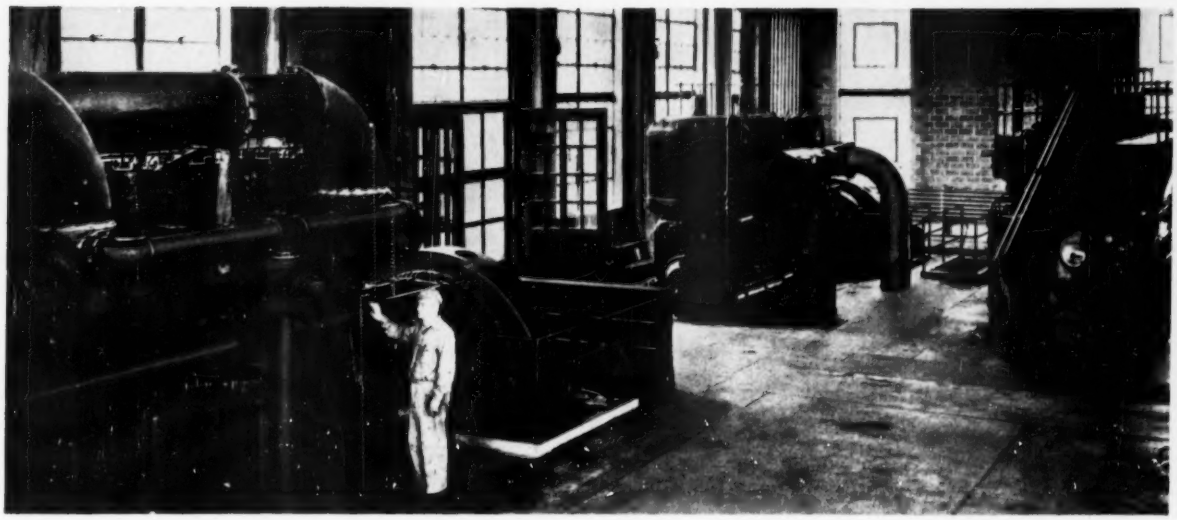
**ANACONDA®**

*Tubes and plates for condensers and heat exchangers • welding rods • American Flexible Metal Hose and Tubing • American Vibration Eliminators*

**For more data circle 520 on Post Card**

H. L. Ostness, Chief Engineer, River Falls Municipal Utility, Wisconsin, says...

# "Sticking Rings are no problem in this Plant"



Mr. Ostness, as chief engineer of one of the oldest Municipal Power Plants in Wisconsin, knows diesels – *knows how to get the most out of them.* Mr. Ostness recently wrote, "We have used Sinclair Lubricants for over fifteen years very successfully. GASCON[00] and RUBILENE[00] H.D. have been doing an outstanding job in our diesels. Stuck rings is a trouble we know nothing about – engine wear is at an absolute minimum. With results like these, we'd recommend Sinclair Lubricants any time."

If your present lubricants do less, why not let Sinclair help you get longer life from your diesels – with less trouble. Contact your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

## SINCLAIR DIESEL LUBRICANTS

*save wear and replacement*

For more data circle 521 on Post Card

BOOM LOADING "GENTLES" THE COAL INTO WAITING CARS . . .
MAINTAINS INITIAL SIZING AND BANS DEGRADATION

# BEACON COAL

## EASTERN GAS AND FUEL ASSOCIATES

PITTSBURGH • BOSTON • CHICAGO • CLEVELAND • DETROIT • NEW YORK
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For New England: New England Coal & Coke Co., For Export: Castner, Curran & Sullitt Inc.

For more data circle 523 on Post Card

# More Hydro Power from Osage

The design and construction of the initial installation of the Osage Hydroelectric Development, comprising six units of 23,887 kva each, was completed by Stone & Webster Engineering Corporation in 1931.

To provide additional power to meet the system's growing requirements, and following an engineering analysis by the engineers of Union Electric Company of Missouri, decision was reached in 1951 to employ Stone & Webster Engineering Corporation to install two additional units of 23,887 kva each, bringing the total capacity of Osage to 191,096 kva.

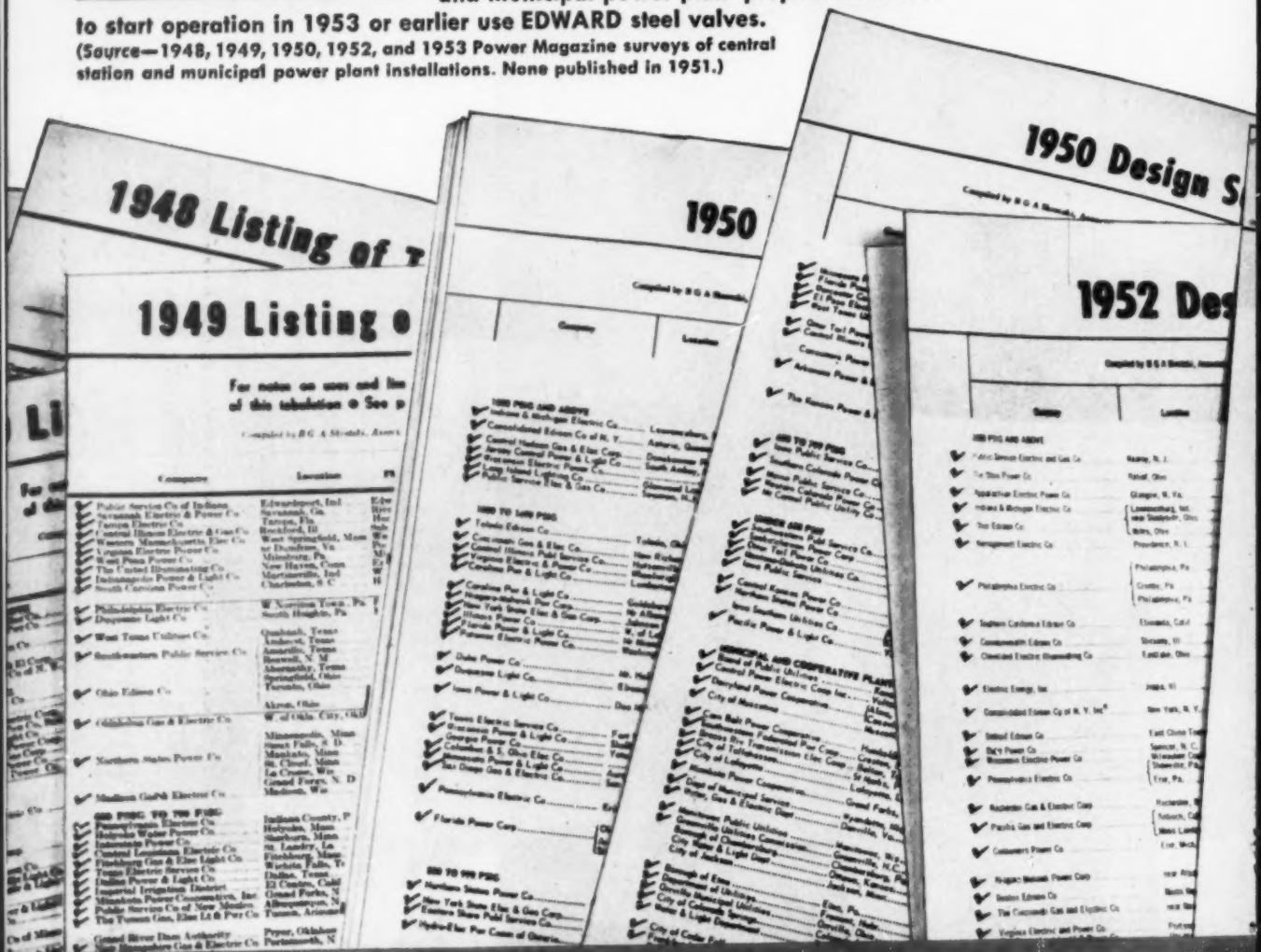
**STONE & WEBSTER ENGINEERING CORPORATION**

A SUBSIDIARY *of* STONE & WEBSTER, INC.

# Again it's Edward Valves in over

**THE EVIDENCE:** **575 out of 598 (96.15%) of new central station and municipal power plant projects scheduled to start operation in 1953 or earlier use EDWARD steel valves.**

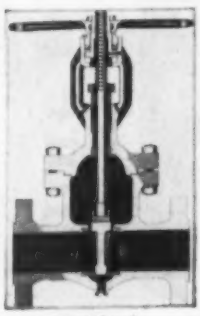
**(Source—1948, 1949, 1950, 1952, and 1953 Power Magazine surveys of central station and municipal power plant installations. None published in 1951.)**




## TYPICAL EDWARD DESIGNS GOING INTO NEW STATIONS

Cast Steel Non-Return

Cast Steel Stop



Cast Steel Gate

Cast Steel Check

Forged Gage

Forged Stop

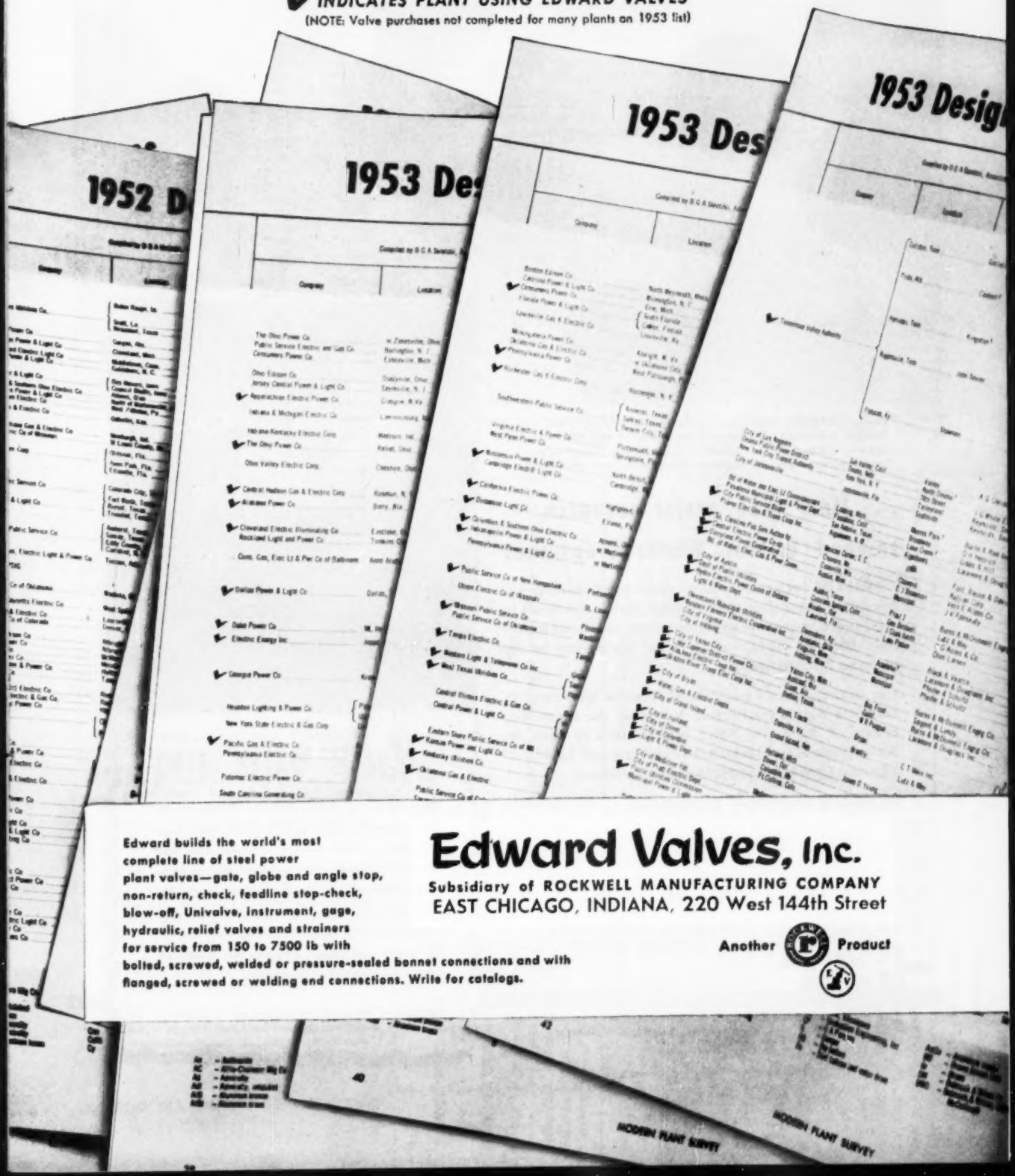
Blow-off

Forged Instrument

Forged Univalves

# 96% of new power plant projects

✔ INDICATES PLANT USING EDWARD VALVES
(NOTE: Valve purchases not completed for many plants on 1953 list)



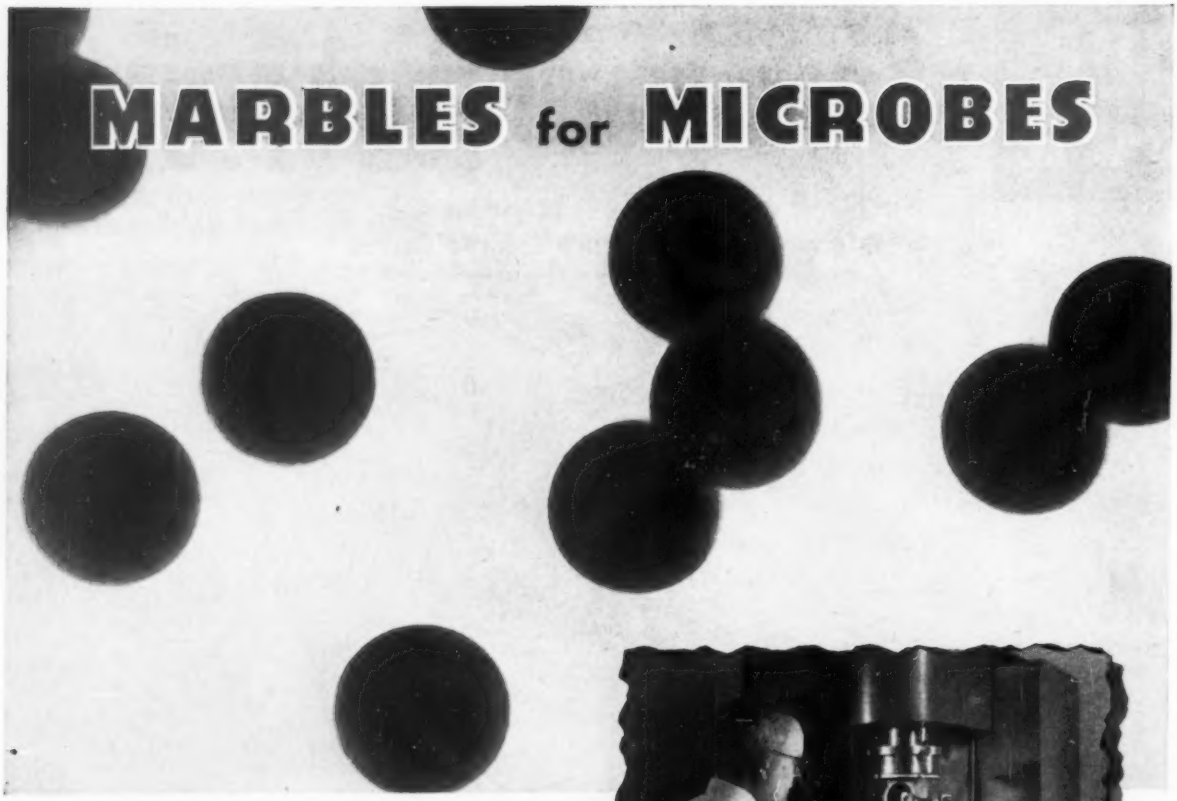

**Edward builds the world's most complete line of steel power plant valves—gate, globe and angle stop, non-return, check, feedline stop-check, blow-off, Univalve, instrument, gage, hydraulic, relief valves and strainers for service from 150 to 7500 lb with bolted, screwed, welded or pressure-sealed bonnet connections and with flanged, screwed or welding end connections. Write for catalogs.**

## Edward Valves, Inc.

**Subsidiary of ROCKWELL MANUFACTURING COMPANY**
EAST CHICAGO, INDIANA, 220 West 144th Street

**Another Product**

# MARBLES for MICROBES



*Above*—100,000X enlargement of latex spheres used to calibrate electron microscope in Nalco Laboratories. Actual diameter of spheres is 0.25 microns—.00000975 inches! *Right*—Inserting specimen holder in vacuum chamber of Nalco electron microscope.

## . . . How they assist research toward better Water Treatment

PERHAPS even too small to make good marbles for microbes, these tiny spheres help Nalco Scientists in their investigations of the microscopic realms of matter only recently made visible to the human eye by the electron microscope.

Use of the electron microscope in water treatment research is significant because it typifies the continuing efforts of the entire Nalco organization to keep the Nalco System representative of the first and best in all phases of modern industrial water treatment.

If you are not already participating in the economy and efficiency of the Nalco System in your plant, write for details on real water treatment security today.

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*In Canada: Alchem Limited, Burlington, Ontario*

THE *Nalco*®
***SYSTEM . . . Serving Industry through Practical Applied Science***

## *Nalco* WATER TECHS

**New reprint of A.S.M.E. Paper No. 52-A-30: *Experimental Studies of Boiler Tube Metal Temperatures: Effect of Heat Transfer Rate and Deposit Thickness*, gives technical data on high-heat-transfer-rate effects (140,000 to 300,000 Btu/sq. ft./hr.) at pressures from 250 to 2500 p.s.i. 16 pages, with tables and diagrams. Author: C. Jacklin, Director, Engineering Research, National Aluminate Corporation.**

*Your Copy Free Upon Request*

**For more data circle 525 on Post Card**

# Helpful Bulletins

**THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. Circle item numbers of all catalogs wanted on the postage-free card below, detach and mail**

## WATER TREATING

**101 Anti-Foam Treatment** — Bulletin 5008-B explains how company's Formula 659, a polyamide anti-foam treatment for boiler and feedwater, acts to condition sludge, improve steam quality, reduce blowdown loss and prevent pitting. Gives tips on application of this powder (also available in briquette form) and tells dosages. Dearborn Chemical Co.

**102 Ion Exchange Softening** — Eight-pp illustrated Form S-105 provides information needed for accurate specification of water softener equipment for industrial plants and institutions where hardness-free water is required or desired. Gives data on valves, as well as chart-type specifications on many sizes of softener units. Illinois Water Treatment Co.

**103 Solids Contact Reactor** — Bulletin 5001-A, 24 pp, discusses a solids contact reactor for clarifying and/or lime softening of water. Explains major advantages of this principle, including its catalytic effect, accelerated reactions and larger precipitates, cutting down of detention time, production of more completely treated water, and saving of chemicals. Cochrane Corp.

**104 To Rout Scale, Rust** — A 28-pp booklet, Form 4305-R-13, details use of company's Compound 32 in removing hard water scale and rust deposits. Gives advantages of its use, tells methods of use including safety measures to be observed when using acid solutions. Tells use of this compound in diesel engine cooling systems, surface condensers, heat exchange equipment. Oakite Products, Inc.

## BOILERS AND AUXILIARIES

**105 Steam Boilers** — A new method of heat transfer called "Cyclonic Combustion" is discussed in this bulletin. Descriptive drawings show how air is introduced into combustion chamber at high speeds in revolving spiral vortex, radiating heat to fire tube through direct radiation and convection. Cyclotherm.

**106 Pulverized Fuel Systems** — Well-illustrated, 32-pp Bulletin BP-53-3 presents ball mill pulverized fuel systems for the grinding and burning of solid fuels — coals, coke, coke breeze and lignite. Text gives advantages of the system and a large cutaway shows design features. Typical installations are also pictured. Foster Wheeler Corp.

**107 Feedwater Heater** — Bulletin S-217, 6 pp, describes a baffle spray type deaerating feedwater heater. Lists special features including counter flow principle, vent condensers, and engineering for individual job requirements. Shows how unit saves fuel, reduces boiler repairs and stops corrosion caused by oxygen and carbon dioxide. Stickle Steam Specialties Co.

**108 Oil-Gas Burners** — Bulletin 5052 is a 16-pp illustrated catalog describing horizontal rotary oil burners, combination oil-gas burners, and forced draft packaged burners for oil and combination oil-gas firing. Covers features of the burners, including Oil Volumeter, prewired control panels, ignition system, oil pre-heating apparatus. Iron Fireman Mfg. Co.

**109 Burner Equipment** — Form 3048 is a 20-pp general catalog of commercial-industrial automatic heating and power equipment. Tells how to select a burner and describes burners and controls. Illustrations include schematic drawings. Petro.

## PUMPS, PUMPING

**110 Controlled Volume Pumps** — Complete data on manufacturer's "Mini-Pump" line of controlled volume pumps are given in this 10-pp bulletin. Included are capacities, pressures, materials of construction, operating data. Milton Roy Co.

**111 Little Pump for Big Job** — A small, compact pump designed to do a big job economically is described in this bulletin. Explains design and maintenance features of this low cost pump for water softening and boiler treatment service up to 300 psi. Orchem Pump Div., Orlich Bros. Machine Works.

**112 Multistage Centrifugal Pumps** — Two, three- and four-stage pumps for heads to 650 psi and with capacities from 50 to 850 gpm are described in 8-pp Bulletin 237-C. Pictures construction details of these pumps, gives general specifications, tells how and where to use them. Pennsylvania Pump & Compressor Co.

## VALVES, TRAPS AND PIPING ACCESSORIES

**113 Control Valves** — Bulletin LB-1, 9 pp, describes construction, features and operation of company's control valves. Characteristics of split body construction and cylinder motor are treated. General specifications, capacity factors and flow formulas are given. Conoflow Corp.

**114 Pump Valves** — Sixteen-pp Catalog SC-510, now available to power engineers, describes and illustrates valves made to fit practically all makes of reciprocating pumps. Key features of the valves are discussed, and standard, lock-in and deck types are covered in detail. Sims Pump Valve Co., Inc.

**115 Reducing Valves** — Bulletin 511-A describes small flow bronze or steel reducing valves for steam, air, gas, or liquid service. Discusses applications in fields where small flows are a problem. Capacity tables to facilitate sizing included. Leslie Co.

**116 Pop Safety and Relief Valves** — Explanation and description of these valves for steam, air, gas and liquids are given in Bulletin 502, 12 pp. Provides steam, air and gas relieving capacity tables. The Lunkenheimer Co.

**117 Thermodynamic Steam Traps** — Eight-pp Temporary Bulletin 255A in-

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troduces manufacturer's new thermodynamic steam traps, small units designed for convenience of installation and ease of maintenance. Explains their applications in steam mains and separators, and where conditions of water hammer and corrosion are present. Sarco Co., Inc.

**118 Expansion Joints** — Eight-pp Catalog 133, on manufacturer's Flexon line of expansion joints, gives basic data for selection and application of pipeline expansion joints. Discusses types of pipeline motion frequently encountered and methods of handling such motion. Gives specifications for low and high pressure units. Flexonics Corp.

**119 Wrought Iron Nipples** — This informative little folder explains how to identify wrought iron nipples. Provides dimensional data and lists stock sizes and lengths for standard weight and extra strong types. Covers nominal size, close nipples and special types, black and galvanized. A. M. Byers Co.

**120 Welding Fittings** — Intended as supplemental data for company's general catalog, this illustrated folder presents 90- and 45-deg long radius elbows, caps, straight and reducing outlet tees. Provides sizes, weights. Tube Turns, Inc.

**121 Corrosion-Resistant Fittings** — Fittings designed for use with light-wall pipe and described in this 24-pp catalog feature the tangential section as a new concept in piping. Explains how these fittings reduce initial costs and simplify piping installations and are readily adaptable to existing pipelines and valves, other equipment. Horace T. Potts Co.

**122 Pipe Tools** — A new aluminum power drive combining lightness and durability is featured in this illustrated bulletin. Explains portability of the drive, easy threading and cutting operations. Also described are pipe cutters, nipple chucks, chip strainers. Beaver Pipe Tools, Inc.

## ELECTRICAL

**123 Time Switch** — Selection and application information on time switches, process timers and time meters are discussed in Catalog GEA-5965, 24 pp. Available types and models are described, as well as features, specifications, operating data. General Electric Co.

**124 Magnetic Air Circuit Breaker** — Design and construction features of magnetic air circuit breaker arranged for installation in horizontal drawout switchgear rated 13.8 kv are described in Bulletin 18B7993. Diagrams show how breaker interrupts short circuit current; text gives purpose of arc chute and contacts. Allis-Chalmers Mfg. Co.

**125 Current-Limiting Reactors** — Eight-page Bulletin GEA-976C discusses uses and characteristics of cast-in-concrete reactors for single and three phase circuits of 34,500 v and below. Construction of reactor is described and indoor and outdoor applications cited. General Electric Co.

**126 Dry Type Transformers** — "Operation and Maintenance of Dry Type Transformers" is a brief manual written to guide electricians, maintenance personnel in the proper installation and care of these transformers. Simple trouble chart included. Hevi Duty Electric Co.

## . . . Outstanding Among This Month's Catalogs

**127 Refractories for Heat, Power** — Compiled to help power engineers solve refractory problems and get greater operating efficiency from their boilers, this booklet provides 32 pp of practical information on company's Crystolon refractories. Properties and characteristics of these silicon carbide products are given and separate chapters cover those for air-cooled, solid wall and water tube protection, and for laying brick and repairs. Suggested uses in various types of boilers are illustrated. Norton Co.

**128 Lubrication of Chain Drives** — Vol. 39, No. 8 of Lubrication offers a 10-pp discussion on chain drives and their lubrication. Covers types of chains, conditions affecting their lubrication, choice of lubricants. Includes table showing lubricant recommendations for chain drives. Generously illustrated with photos and sketches showing chain arrangements, methods of lubrication. The Texas Co.

**129 Got a Wiring Problem?** — Power engineers concerned with electrical wiring installations, maintenance of electrical power, and new construction, will find much of interest in this 24-pp booklet on rigid steel conduit and electrical metallic tubing. Tells how to plan rigid conduit wiring installations for maximum comfort, service and expansion. National Electrical Manufacturers Assn.

**130 Propeller Fan** — Thirteen types of fans, including panel, high pressure and direct-drive low-noise model are shown in Bulletin A-109, 40 pp. It describes three types of roof, ventilators, unit heaters and intake air units. Includes specifications, dimensions and performance figures on all equipment, also engineering data. Discusses corrosion-resistant materials and coatings. Hartzell Propeller Fan Co.

## MATERIALS HANDLING

**131 Conveying Systems** — How this manufacturer's conveying systems are being used in handling dry pulverized and granular materials is shown in illustrated Bulletin FK-26, 16 pp. Types of systems and component parts are described and typical installations are pictured, including conveying and unloading applications in several industries. Fuller Co.

**132 Elevator Buckets** — Bulletin 2465, 12 pp, describes manufacturer's cast malleable and Promal elevator buckets for handling coal, coke, ores, grain, cement, chemicals, etc. Fifty-five standard sizes are listed, and tables of dimensions, weights and capacities are given. Also provided is information on mounting. Link-Belt Co.

## INSTRUMENTS AND CONTROLS

**133 Remote Level Indicators** — Twenty-pp Bulletin WG 1824 presents remote liquid level indicators for boilers, heaters, storage tanks, discussing applications and outstanding features of these easily read indicators. Explains how they

(*Continued on page 133*)

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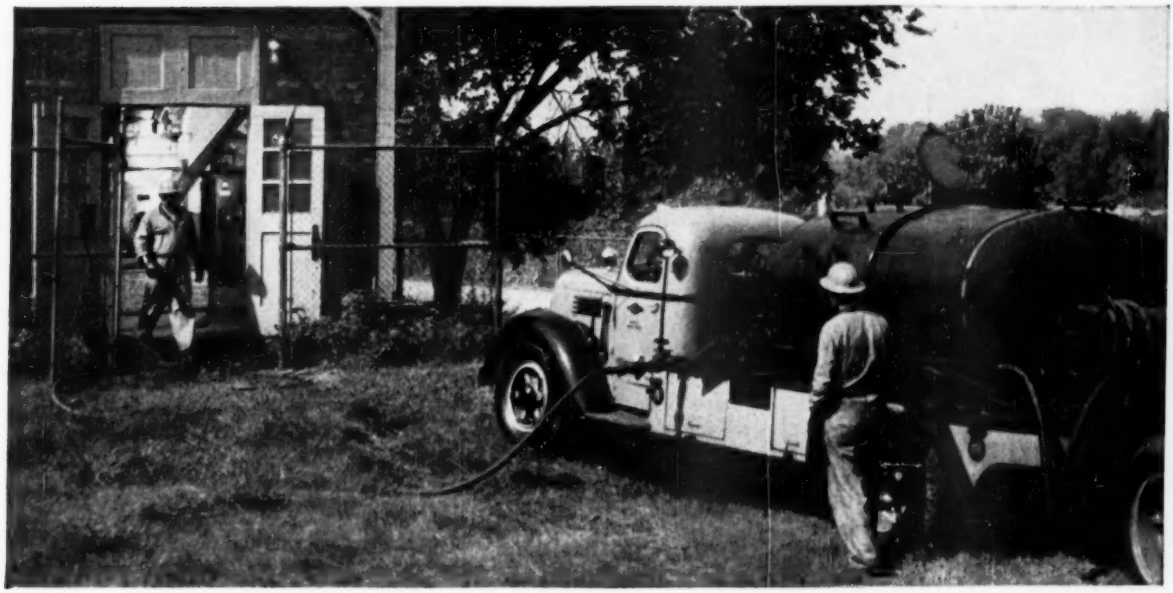
# WATER WELL PRODUCTION TRIPLED BY DOWELL SERVICE

## Chemical treatment removed retarding scale from equipment . . . reduced cost of water



A well drilled to a total depth of 205 feet into Niagara limestone had declined to 70 gallons of water per minute—a rate far below its capacity to produce. Needless to say, management was quite concerned about the increasing costs of its water.

Dowell Service was called in to survey the job. First tests showed the pump to be clogged badly with iron deposits. Other tests showed the entire well system to be fouled with the same material.

After a Dowell acidizing treatment, the well produced 230 gallons of water per minute—its original capacity! Management was so pleased with these results that a program of periodic maintenance treatments was instituted for *all* its water and waste disposal wells and auxiliary equipment.

How about your equipment? Is it delivering full capacity for you? If there's any question, call in Dowell for a free estimate. Dowell is equipped to provide chemical cleaning service—with special truck-mounted tanks, mixers, pumps to prepare and deliver necessary solvents . . . and experienced Dowell engineers to do the job for you.

For complete information on how Dowell Service can help solve your production and maintenance problems, call your nearest Dowell office or write to Dowell, Dept. L-24, Tulsa 1, Oklahoma.

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Boilers • Condensers • Heat Exchangers • Cooling Systems
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# Looking for the right packing for your centrifugal pumps?

## For shaft speeds to 1750 RPM Johns-Manville Centripac seals better

WEAR on centrifugal pump shafts as well as on oscillating and rotating rods of other equipment is minimized by J-M Centripac. This is because the square cross section of this packing provides the maximum contact surfaces. Thus, it insures a tight seal with the least friction and gland pressure.

Because Centripac is plaited square it retains its shape indefinitely, thus maintaining maximum surface contact for long periods of time. It is made from long-fiber asbestos yarn, thoroughly lubricated and graphited. It seals against fresh or salt, hot or cold water, oil, ammonia, brine, gasoline, and certain weak acids and other chemicals. Because of its wide application, it is a favorite of plant men everywhere.

For general service, Style #7 Centripac is recommended. It contains no wire, is soft enough to conform readily to the packing space, and stands up well in service. It comes in coil form, Style #C-7 and Ring form, Style #R-7. Sizes 3/16" and up.

## For higher shaft speeds, J-M Plastic Packings reduce friction and scoring of shafts and sleeves

Higher centrifugal pump speeds make friction increasingly important in packing and shaft life. That is why J-M Plastic Packings have been designed to have the homogeneous structure and low friction so essential to long packing life in this service.

The exact composition of these packings varies according to the service conditions for which each particular style is designed. As an example, one of these, Style No. 610 is an excellent general maintenance packing for service against steam, air, ammonia, gases, etc. up to 550F. It is made of selected asbestos fiber mixed with pure graphite and a small amount of non-friction metal, then bonded with a heat-resisting compound to form a pliable coil or spiral. It is furnished in sizes of 1/8" and up.

**YOUR J-M PACKING DISTRIBUTOR** will gladly recommend the right packing for your equipment, and furnish it from stock for your immediate requirements. Write Johns-Manville, Box 60, New York 16, N. Y. for his name and address. In Canada, 199 Bay St., Toronto 1, Ontario.

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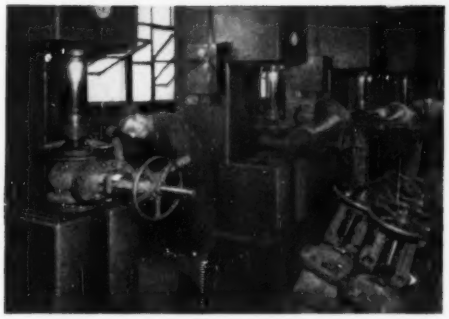


# *The Finishing Touch*

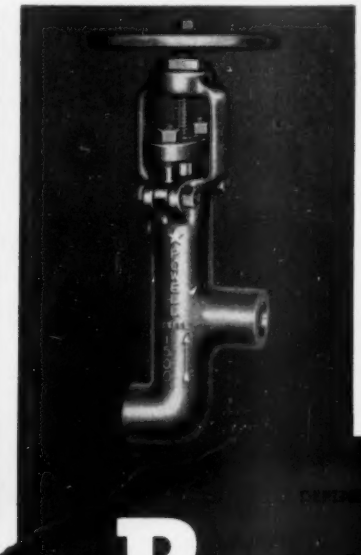
Small details can make a big difference in trimming a tree . . . and in manufacturing valves. For example, *every* Powell Valve part must pass *rigid inspection.* Then, as a final, finishing touch, each Powell Valve is subjected to *actual line tests.*

It's these seemingly small details that have helped Powell Valves maintain their record of dependability since 1846. Powell has probably done more valve research, solved more valve problems, and makes more types of valves than any other organization in the world.

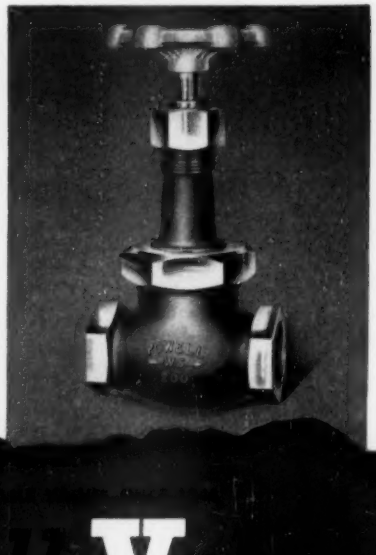
With Powell Valves on the job in your plant, you'll say every day's a holiday from flow control worries. Following are just a few of the valves that have the gift of dependable service you want—and need. They're available through distributors in principal cities. If a distributor is not located near you, just write us. We'll be pleased to tell you more about these valves—and our complete line.

**PRESSURE SEAL CAST STEEL GATE VALVE** *(Fig. 11303).* 1500 pound. Many proven advantages and exclusive features. Pressure Seal Valves are also available in Non-Return, Check, Globe and Angle Patterns for 600, 900, 1500, 2500 pounds.

**INTEGRAL BONNET OFFSET GLOBE VALVE** *(Fig. 1331-A).* 1500-pound. One-piece construction eliminates possibility of leakage between body and bonnet. Sizes ½" to 2", inclusive.



**BRONZE "W.S." FULL FLOW GLOBE VALVE** *(Fig. 2608)* for 200 W.P. Stainless steel seat and disc. Nominal pipe size opening through seat permits fuller flow with pressure drop and turbulence cut to minimum.



**Powell Valves**

# *Announcing* Foster Wheeler's new

## completely tooled to effectively meet your most exacting needs for steam generators, heat-transfer and process equipment!

---

**1. 8000 TON BEAM PRESS**
Hydraulically operated, will bend steel plates 40′ long, 8″ thick.

**2. PLATE EDGE PLANER**
Will take the longest available plates, for cutting welding grooves.

**3. OVERHEAD CRANES**
Four large cranes capable of lifting the heaviest and largest equipment easily.

**4. DOUBLE HOUSING PLANER**
Highest speed planing.

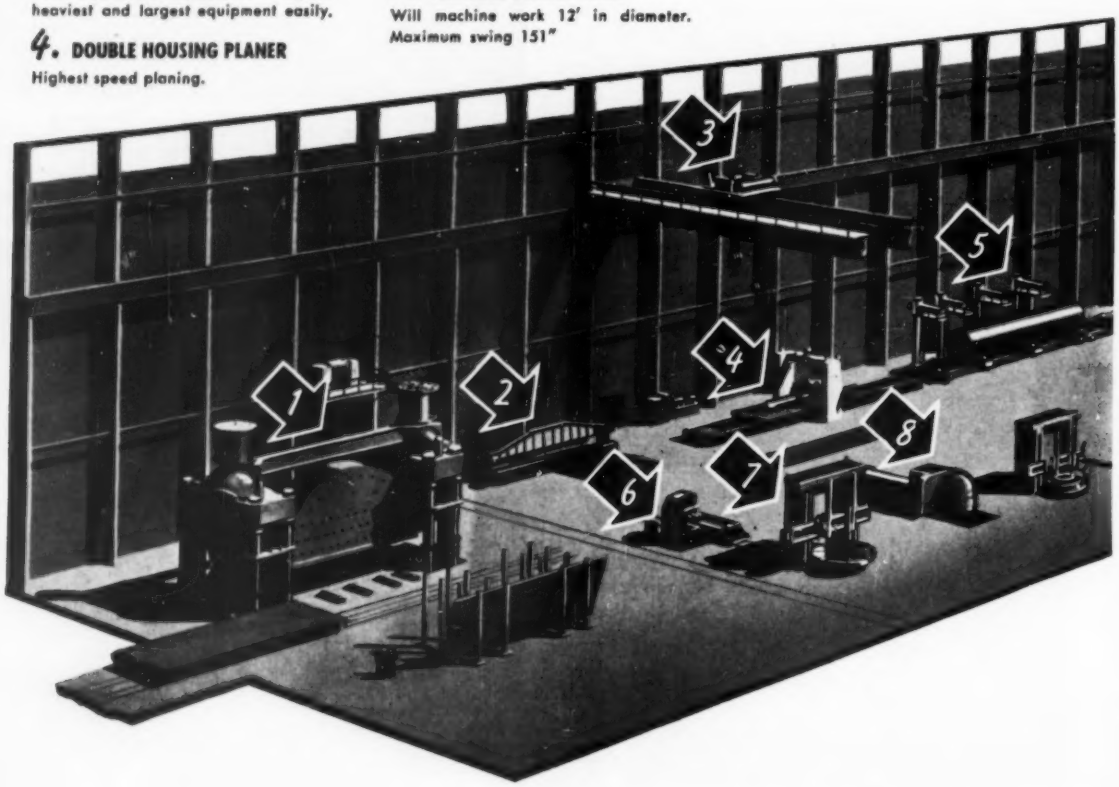
**5. AUTOMATIC WELDING MACHINES**
Submerged-arc, automatic flux recovery-type, mounted on track.

**6. 500 TON CRIMPING PRESS**
For cold-bending edge of plate preparatory to rolling.

**7. VERTICAL BORING MILL**
Will machine work 12′ in diameter. Maximum swing 151″

**8. BENDING ROLLS—PINCH TYPE**
By hot or cold rolling will form cylinders for medium-pressure vessels.

**9. HIGHEST SPEED DRILLS—RADIAL TYPE**
These are mounted on ways and tracks, power positioned.

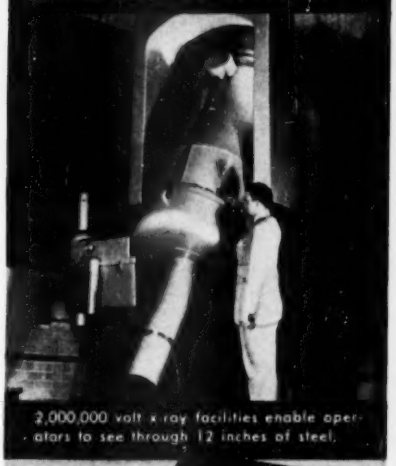


# Mountain Top plant...

Artist's drawing of Foster Wheeler's new Mountain Top plant near Wilkes-Barre, Pa.

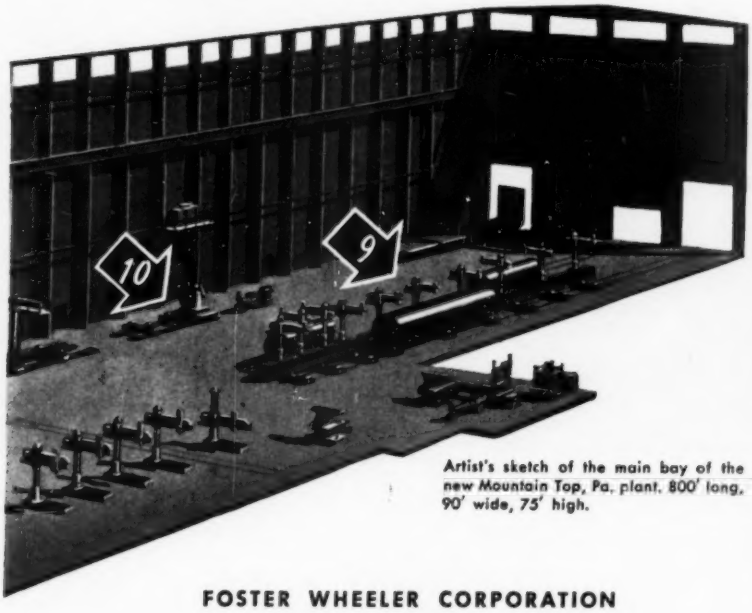
ANTICIPATING your requirements for more efficient central station, industrial and process components, Foster Wheeler has installed in this new plant, near Wilkes-Barre, Pa., the latest, most modern equipment, such as: the 8000-ton beam press, 2 million volt x-ray facilities, the newest developments in submerged arc-welding and high-speed drilling equipment, 83½ foot long stress-relieving furnace and others shown here.

This modern equipment, plus the plant's proximity to steel supplies, and its strategic location for direct rail shipment to all areas of the country, assure you of fast, economical, high-quality fabrication to meet your specifications for the largest and heaviest drums and pressure vessels.



2,000,000 volt x-ray facilities enable operators to see through 12 inches of steel.

***10.*** **DRUM FACING MACHINE**
Quick preparation of ends of cylinder for assembly with heads.




Artist's sketch of the main bay of the new Mountain Top, Pa. plant. 800' long, 90' wide, 75' high.

Stress relieving furnace permits annealing of fabricated parts more than 83 ft. long.

Shot blast building is equipped for surface cleaning by latest practice.

Plate normalizing furnace will take the largest available plates for preheating prior to bending or rolling.

**FOSTER WHEELER CORPORATION**
*Designers and Constructors of*
Stationary and Marine Steam Generators and Condensers
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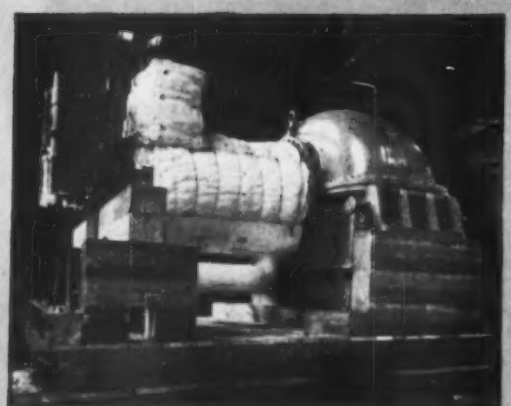
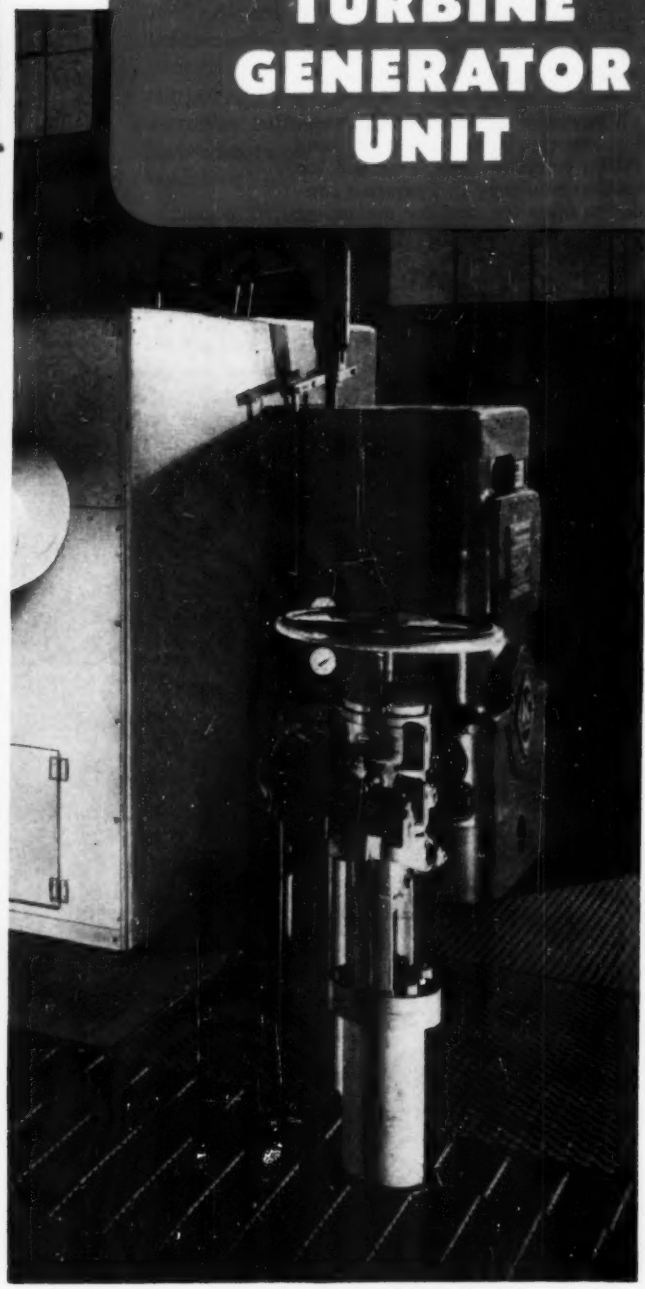
# Another



To simplify installation, both turbine and generator are shipped as complete assemblies with rotors locked in place. Turbine insulation is also applied at factory. Illustration at left shows 7500-kw turbine ready to be covered with tarpaulin before shipment.

Attractive appearance of WA-Series turbine and generator is shown above. Unit is rated 7500 kw, with steam conditions of 600 psig, 825 F, 1½ inches mercury absolute. A-C also supplied surface condenser, pumps and motors for this installation.

# *WA-Series*
# STEAM TURBINE GENERATOR UNIT



## Engineered to Meet Requirements of a Modern Power Plant!

HERE'S another Allis-Chalmers WA-Series turbine generator unit with the kind of design features and performance that power producers everywhere are looking for today.

Available for condensing and non-condensing service, the up-to-date WA-Series impulse turbine design is built in sizes 2000 kw and larger in NEMA standard ratings. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

### Simplicity is Keynote

For ease of installation and maintenance, every detail has been designed to assure maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit with simple foundation requirements. And shipment of the turbine and the generator with their rotors in place further minimizes installation costs.

Completely coordinated in design, these modern generating units are manufactured, assembled and tested in one plant under unified supervision.

For a detailed story of the WA-Series features that can help you reduce costs, ask your A-C representative for Bulletin 03B7654, or write to Allis-Chalmers, Milwaukee 1, Wis.

A-4112

# ALLIS-CHALMERS

A-C ALLIS-CHALMERS

# Application engineering . . . *essential to control*

No matter what the product, every plant uses methods, materials and equipment that present problems peculiar to its own production. Specifications . . . size of plant . . . rate of output . . . all impose further unique restrictions.

What, then, about process control instrumentation? To do its job right, it has to be designed with all those factors . . . and many others . . . in mind. And here is where Honeywell Application Engineering steps in.

First comes a thorough investigation of control requirements. A Honeywell engineering representative, well versed in instrumentation techniques sits down with process engineers, production men, and instrument technicians . . . discusses details of the specific process. Then he puts the problem up to Honeywell's staff of application engineers.

**Specialists for Each Industry**

In this group are men who are expert in each specific industry. One group, for example, specializes in instrumentation for the metalworking industry . . . another for chemical . . . another for petroleum . . . until the whole gamut of modern manufacturing is represented. Each man has been trained, by education and first-hand experience, in the techniques of processing and process control in the area of his interest. Each is a living part of the industry he serves. And he knows why and where every process "is different."

**Covers All Aspects of Control**

Honeywell application engineering covers the entire control installation. It works out details of what instrument to use for each measurement or control function . . . what type of primary element . . . what control system . . . what size and style of valve. It provides all essential signals, safety interlocks, and accessories. It combines all these elements into a complete unit, arranged for peak production efficiency . . . greatest convenience of the operator, and for maximum ease of service . . . custom-fitted to the individual needs of the process to be controlled.

**Saves Time . . . Produces Top Performance**

This Honeywell service gives specialized consultation on complex control problems that would otherwise require the attention of experts in the individual plant. But most important, it assures a control system that will produce the superior performance that Honeywell instruments are capable of giving . . . and which will help to obtain the most production and best quality from the process which it serves.

# Remote measuring *centralized*

**SOUND PLANNING**, *based on specialized engineering experience, forms the basis of Honeywell Application Engineering. Here a round-table discussion between customer and Honeywell technicians irons out the initial control requirements for a process.*

H HONEYWELL

WHEREVER you need to bring measurements of flow, liquid level and pressure from out in the plant to a central control room, you'll find Brown remote measuring systems provide the performance you need. Utilizing pneumatic transmission, these systems consist of an appropriate transmitter and sensing element at the point of measurement—connected by small-diameter tubing to recording and controlling instruments on the main or auxiliary control boards.

**They're accurate:** operate over distances of several hundred feet with full responsiveness. Transmitter and receiver are precision-matched in design.

**They're dependable:** rugged design keeps calibration constant, from detection to final measurement. Simple construction minimizes maintenance.

Brown pneumatic transmission systems are supplied in a wide choice of ranges for power plant service.

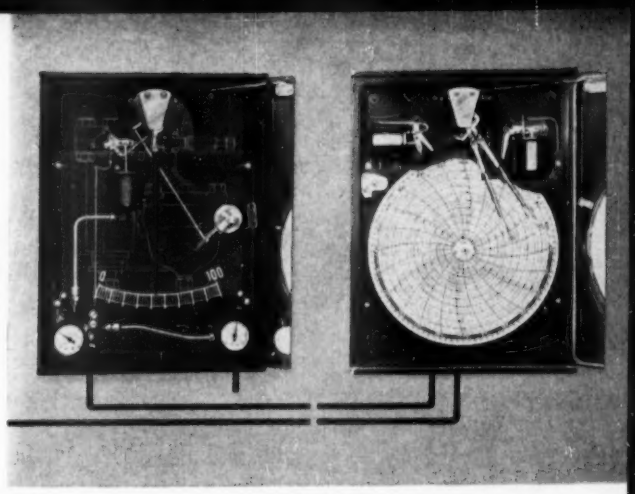
# systems for *plant control*

Electric systems are also available for these same variables. Your local Honeywell engineering representative will welcome the opportunity to discuss your own plant's applications . . . and he's as near as your phone.

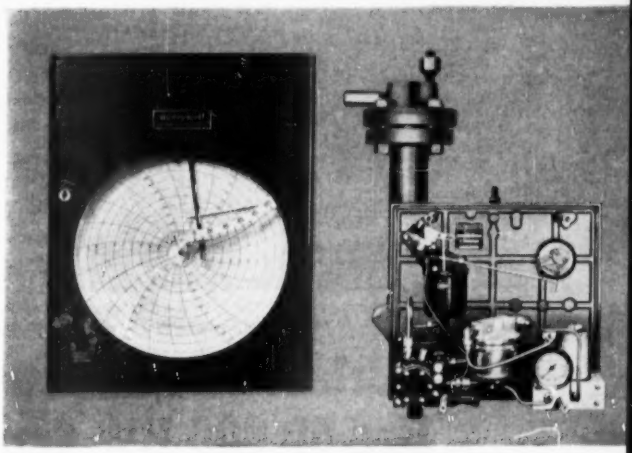
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4587 Wayne Ave., Philadelphia 44, Pa. Sales and service offices in more than 90 principal cities of the United States and Canada.

● **REFERENCE DATA:** Write for Catalog 90-2, "Supervisory Instruments for Power Generation," and for Data Sheet No. 9.1-4.

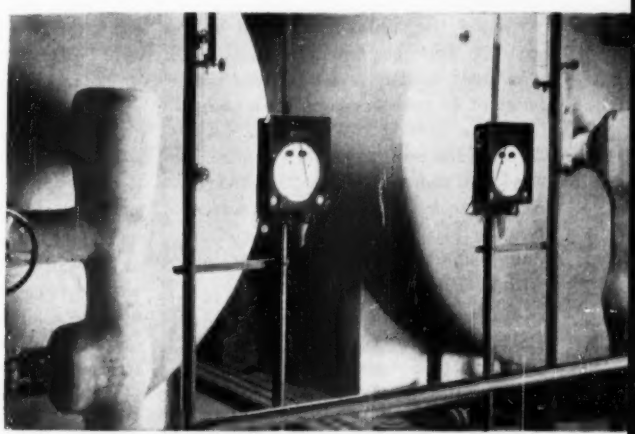
MINNEAPOLIS
**Honeywell**
BROWN INSTRUMENTS
*First in Controls*



**REMOTE PRESSURE MEASUREMENT:** *Brown systems cover the range from super heat pressures to condenser vacuum. Only low-pressure instrument air goes to the control board. Dangers of high-pressure piping are eliminated . . . panel costs are reduced.*



**REMOTE FLOW MEASUREMENT:** *systems can be either the square root type (electric or pneumatic transmission) or evenly graduated (electric transmission). The latter is ideal for flow cost accounting . . . has a linear scale that provides full readability at all flow rates.*



**REMOTE LIQUID LEVEL MEASUREMENT:** *keep operators informed of level in condensate tanks, hot wells, boiler drums and other remote locations. Systems are supplied for open tanks, closed pressure vessels, corrosive liquids, and liquids containing suspended solids.*

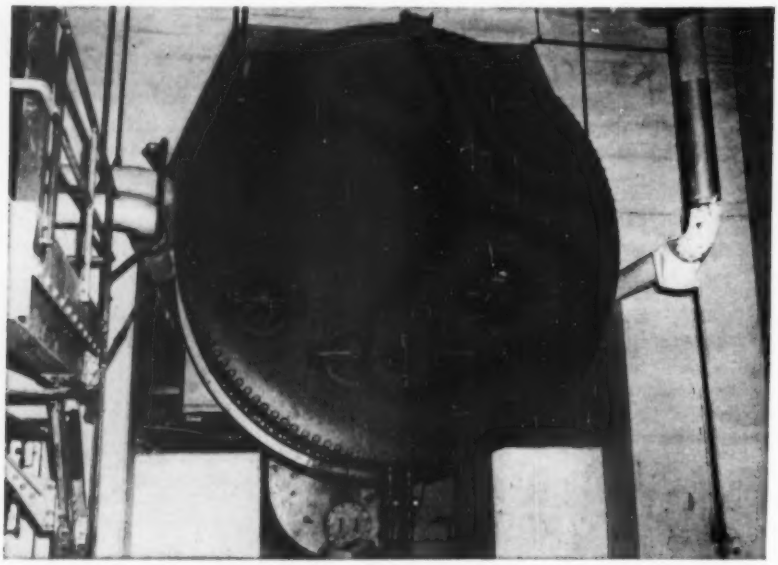
For more data circle 532 on Post Card

BRIDGEPORT BRASS COMPANY

**CONDENSER AND HEAT EXCHANGER TUBE EDITION**

# COPPER ALLOY BULLETIN

Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

One of the five condensers built by The Lummus Company for the Fairless Works Power Station, United States Steel Corporation, Morrisville, Pennsylvania.

## New Fairless Works Power Station Has 60,000 KW Capacity

On a 3,900 acre tract on the bend of the Delaware River south of Trenton, stands the largest integrated steel plant ever built at one time—the great new Fairless Works of United States Steel Corporation.

Among the main features of this vast operation are two blast furnaces, nine open hearth furnaces, two batteries of 87 coke ovens each, slabbing, blooming, rolling and tin plate lines. To serve the mill, there are 75 miles of standard railroad track, 20 miles of roads, 30 miles of sewers, a water-treating plant of 254 million gallons daily capacity, and a power station with a 60,000 kw output.

**Power Station Equipment**

The Fairless Works Power Station uses two turbo-generators, each rated at 30,000 kw to supply its power needs. One generator was built by General Electric, the other by Allis-Chalmers. In addition to the two turbo-generators there are three Ingersoll-Rand blast furnace turbo-blowers, each having a capacity of 110,000 cfm standard air (30" of mercury/60° F) at 35 psig discharge pressure.

The five surface condensers which serve both the generators and blowers were built by The Lummus Company.

**Design Features of Condensers**

Condensers are all of the two-pass, divided flow type. Those serving the turbo-generators each have condensing surfaces of 25,000 sq. ft. Each unit can condense 260,000 pounds of steam per hour (247,000,000 BTU/hr.) at 27.25" of mercury vacuum when supplied with 25,400 gpm of cooling water. Each of these condensers is fitted with 4,590 arsenical Admiralty tubes supplied by Bridgeport. The tubes are 18BWG, 7/8 inch in diameter and 24 feet in length.

The three condensers serving the turbo-blowers each have condensing surfaces of 10,400 square feet. Steam is condensed at the rate of 108,000 pounds per hour (102,800,000 BTU /hr.) at 27.25" of mercury vacuum for each unit. Water circulates at the rate of 11,000 gpm. Tubes are of Bridgeport's arsenical Admiralty—2,204 tubes per condenser. Tube dimensions are 18BWG, 7/8 inch diameter, and 20 feet 10 1/8 inches in length. In all five condensers the cooling water velocity is 6.75 feet per second. Water is drawn from the Delaware and chlorinated before use. Thus far, no trouble has been encountered with the river water.

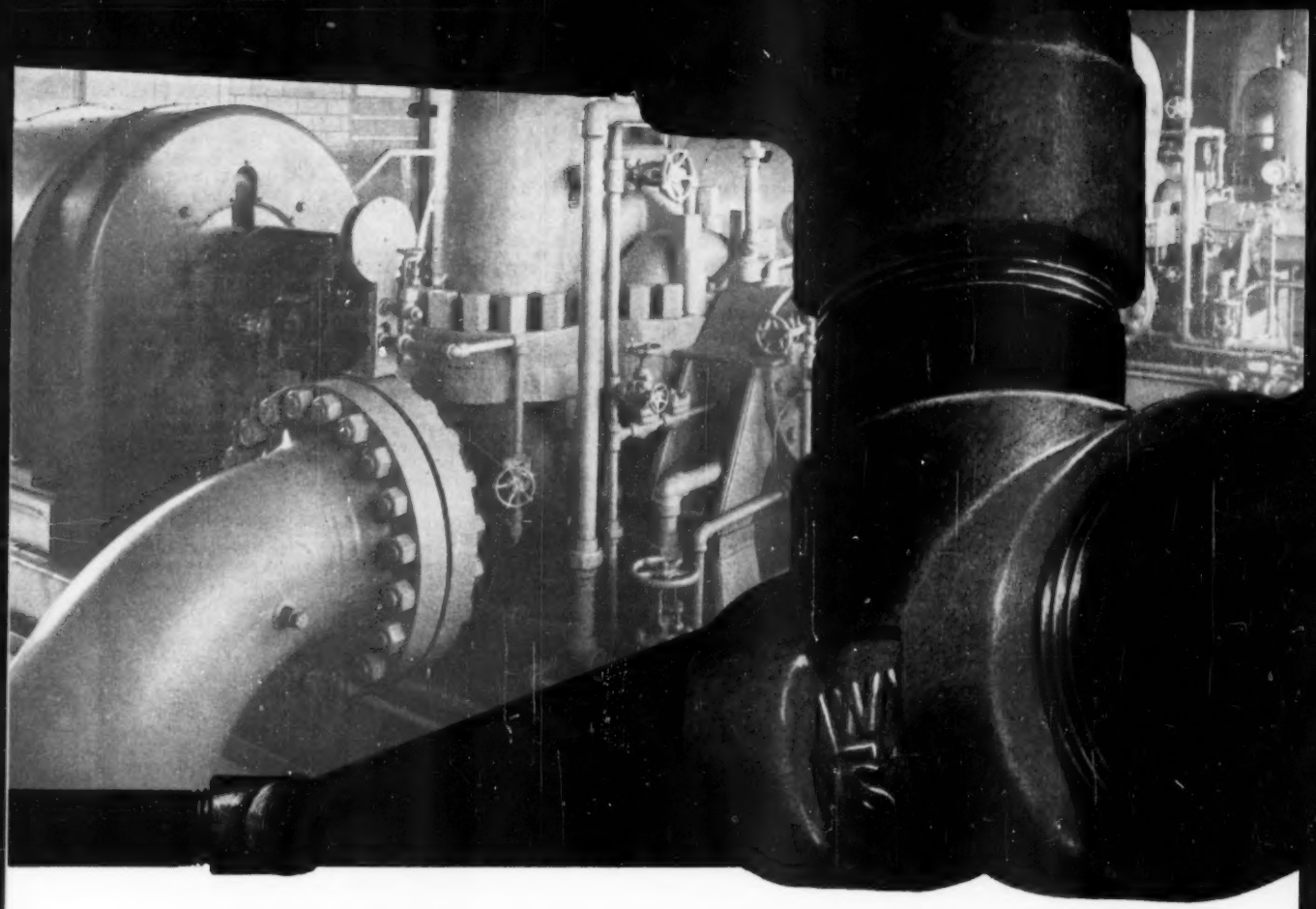
**Choice of Proper Tubing Vital**

Depending on operating conditions and equipment design, the proper choice of condenser tubes plays an important part in the over-all efficiency of a power installation. The Fairless Works Power Station utilizes water from the river that is affected by brackish tides and is somewhat polluted by factory wastes. Under these conditions, arsenical Admiralty is a good choice, especially when the water is chlorinated, for mild chlorination combats slime deposits without attacking the alloy. And, since it contains arsenic which acts as an inhibitor, arsenical Admiralty resists dezincification.

**Bridgeport Corrosion Laboratory**

If you have any problems relating to condenser tubes—from choice of proper tubing to corrosion, fouling or cleaning — Bridgeport Corrosion Laboratory will be glad to work with you. Call the Bridgeport district office nearest you for your condenser tube requirements. Meanwhile, write on company stationery for your copy of the 156-page "Bridgeport Condenser and Heat Exchanger Tube Manual." It is a complete guide to the many types of tubes in use under all varieties of operating conditions. It contains much helpful information on combating corrosion problems. Heat transfer, weight, and dimension tables are also included. Send for your copy today. (643)


For more data circle 533 on Post Card



## In the Power Industry W-S Screw-End Fittings . . .

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*FOR REAL ECONOMY* on your next screwed fitting piping job specify Watson-Stillman the Double-diamond brand of Forged Steel Fittings.

You'll find their long, accurately cut threads, in perfect alignment, assure ease of installation.

You'll find their extra long bands extending well beyond the last thread, provide reinforcement at points of severest strain.

You'll find their heavy uniform fitting wall thickness provides a high safety factor to give you years of leak proof, trouble-free service.

Accurately machined . . . they fit tight and they're made of forging stock especially selected for toughness, strength, and resistance to temperature and shock. Available in carbon, stainless and chrome-moly alloy steels.

Watson-Stillman also makes a complete line of forged Socket-Welding fittings. Investigate these superior, life-of-the-system joints. Write for literature.

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## WATSON-STILLMAN FITTINGS DIVISION

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# Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-free cards on pages 35 and 133 for your request. Just circle the numbers of the items you'd like to know more about

## 1—VANEAXIAL BLOWER

**For high temperature applications, other rugged air handling service**

This vaneaxial blower is announced as capable of moving air at temperatures up to 350 F, or air containing acids, alkalies or fine abrasive dust without fear of premature failure of belts and bearings. A modification of company's standard belt-drive vaneaxial blower, this new high temperature model comes in the same range of sizes — 12 to 54 in. — and air deliveries are the same for the standard models.

On the new blowers, the addition of a special dummy section containing the guide vanes makes possible the location of the drive on the negative pressure side of the blower. With this arrangement, clean air from outside the duct is drawn in through the belt tube and over the bearings, it is explained. And this removal of vulnerable parts from contact with destructive elements in the air stream is credited with affording longer service life and trouble free operation under adverse conditions. Hartzell Propeller Fan Co.

## 2—STEAM TRAP

**Cast steel; side-inlet, side-outlet type with integral strainer**

The mechanism of the No. 983 Steam Trap is corrosion resistant stainless steel; and it is identical in design and construction to the mechanism used in this manufacturer's traps for 900 F, 950 psig duty. Pressure range for the new trap is from 0 to 600 psig; maximum capacity is 4400 lb-hr. Connections are $\frac{1}{2}$, $\frac{3}{4}$, or 1 in. — screwed, flanged or socket weld. The built-in strainer is designed to afford efficient operation where dirt and scale conditions are bad. Armstrong Machine Works.

## 4—PROGRAMMING CONTROL

**For use with commercial-industrial gas, oil or gas-oil burners**

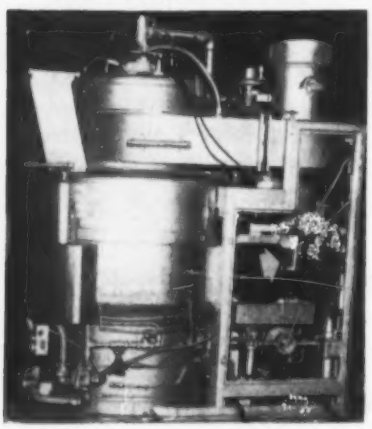
Described as the first control to provide full protection against flame failure explosions together with programming to meet any application requirements, the new Fireye Programming Control incorporates company's flame-sensitive Firetron Cell to shut off fuel in 2 to 4 sec after a burner flame goes out. It is designed to withstand vibration.

According to manufacturer, this control offers simplified specification, installation and maintenance by providing a single standard package unit with automatic startup, operating and shutdown control for any type of burner and a selection of programming times for three types of ignition operation to comply with Factory Mutual Laboratories' requirements. Its fail-safe circuit is designed to prevent operation under any unsafe condition and its plug-in chassis offers accessibility and ease of installation. Installation Bulletin CP522 gives specifications, wiring diagrams and programming sequences of this control. Combustion Control Corp.

## 3—COMBINATION-FUEL STEAM GENERATOR

**Can change from fuel oil to natural gas without interrupting steam output**

A flip of a switch is all that's needed to change fuels with the new Model OKJ-4740 Vapor-Clarkson Steam Generator, says its manufacturer. This feature has been accomplished by incorporating the fuel-oil spray nozzle right into the metal body of the gas burner. When the fuel selection switch (see arrow) is flipped from natural gas to oil, the motorized gas valve opens, releasing oil under pressure to the spray nozzle. Fuel oil is always ready to be released to the combustion chamber, it is noted, because it is continuously circulated through the generator's hydraulic modulating controls. A constant spark and pilot light are provided to assure positive lighting.



This combination-fuel generator is designed to develop full working pressure in less than 3 min from cold water, and to produce 1500 to 5000 lb of steam per hour. Once started, by turning one switch, automatic controls take over to cause the generator to turn on and off and modulate steam output to meet a changing steam demand. Over-all dimensions of the Model OKJ-4740 are 50 in. wide, 80 in. high, and 73 in. long. It is furnished as a complete package, ready for fuel and service connections. Vapor Heating Corp.

## 5—NEW COMBUSTION SYSTEM

**Is designed to extract more heat per fuel unit and eliminate soot**

A new combustion system is described as capable of extracting the greatest possible heat from a given unit of oil or gas by complete and smokeless burning of fuel within the firebox, without soot depositing on firebox walls or boiler tubes. Worth-while reductions in fuel costs are also attributed to this system. In it, conventional units are adapted into an arrangement whereby a special flame shield and metered injection of primary and secondary combustion air produce flash combustion of fuel. This generates a maximum of heat in the combustion chamber, company explains, with maximum pounds of steam developed. Lower stack temperatures, greater efficiency are also reported. Radiant Combustion System, Inc.

## 6—SAFETY RELIEF VALVE

**Is designed to offer higher capacity per size, also low maintenance**

Exclusive features claimed for safety-relief valves in the new Uni-Line 41-W-200 Series include a higher capacity per size than other valves, a free-acting self-aligning disc, and a "floating" guide (adjustable for control) which assists in opening and closing action, as well as affording an additional self-aligning feature. The disc and disc holder are of forged copper alloy.

Advantages attributed to these features include a reduction in size of boiler opening required to mount the valve, and a consequent reduced cost of discharge piping. The smaller size also means a reduction in boiler head room, manufacturer points out, reduction in shipping charges because of the reduced weight, and easy replacement or reconditioning of working parts. The valves are available in sizes from $1\frac{1}{2}$ through 6 in. J. E. Lonergan Co.

## 7—AIR TREATING PLANT

**Combines air conditioner, absorbent reconcentrator in one unit**

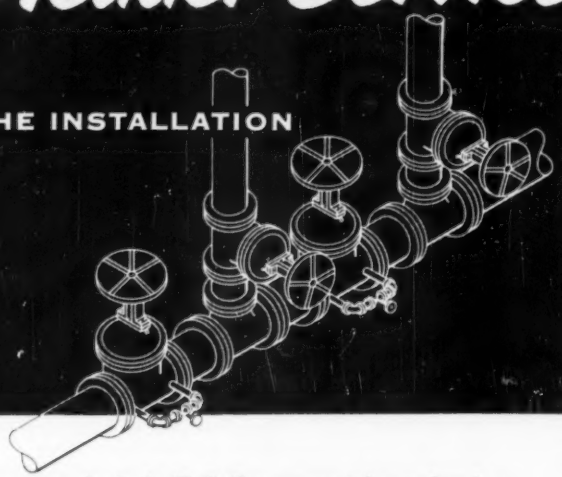
Improved apparatus for treating air with an absorbent spray to fix relative humidity in air conditioning or air drying is announced in the Series 5700. In this, the air conditioner and absorbent reconcentrator are combined in one compact machine unit. The equipment controls humidity, temperature of air.

In the air drying cycle filtered fresh air enters a spray chamber where it is brought into contact with a spray of company's Hygrol, a moisture absorbing liquid. This removes moisture from the air, fixing the leaving air's humidity and temperature according to spray temperature and absorbent concentration.

Correct temperature is obtained by cooling or heating, and air may be dried without temperature change. Correct concentration is maintained by reconcentrating the absorbent (as it becomes diluted) in the concentrator section of the apparatus. Here, by spraying the mixture of absorbent and water in a separate air stream, where heat is added to further the evaporation of water and

# Holding Tight Since 1917 On Boiler Header Service

## THE INSTALLATION



In power plant of a U. S. Government Arsenal, using Crane 14-inch 300-pound steel gate valves in main steam header operating at 135 pounds, 380 degrees F.

## VALVE SERVICE RATINGS

| | |
|---|---|
| SUITABILITY: | No failure in 36 years |
| FEATURES: | 100% heavy duty design |
| MAINTENANCE COST: | No repairs to date |
| SERVICE LIFE: | Installed 1917 – still O.K. |
| OPERATING RESULT: | Increased plant efficiency |
| AVAILABILITY: | Crane catalog item – Current No. 33XR |

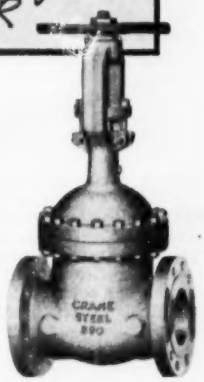
## THE CASE HISTORY

Installed in 1917, these Crane valves have given completely satisfactory service for 36 years without needing repairs of any kind. Inspected in 1951, they showed no undue wear in any part, and a 125-pound hydrostatic test found them absolutely tight. Right back into the header they went, where they're still giving like-new service.

In a period of plant expansion, other makes of valves were tried in the same header service. But those valves gave constant trouble, whereas when replaced with Crane valves, satisfactory results were obtained.

Here's an example of the confidence you can put in a name that traditionally means better quality. For what good is a price without the assurance of product dependability and good value. You're safer—always—when you choose Crane.

## THE VALVE




Here is steel casting skill at its best, by the pioneer in steel valves. Here also is leadership in design and manufacturing that sets Crane Steel Valves apart from the ordinary. Choose these valves for your specific needs from the widest range of body and trim materials, in all pressure classes and sizes, with flanged, screwed, or welding ends. See your Crane Catalog.

*THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON*

# CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
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where a high humidity condition is created to further the separation, the Hygrol is recovered and returned to the air conditioner and water evaporated.

It is explained that in air conditioning by this means, air temperature and moisture content are separate functions — so it is possible to obtain exact control by thermostats. This new dual-function apparatus comes in 1000 to 5300 cfm sizes. They provide equal capacity in less than half the space required by previous models, says their manufacturer. Niagara Blower Co.

## 8—GATE VALVE

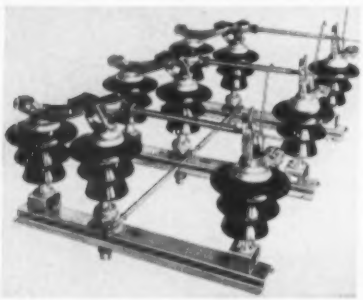
**Of 3 per cent nickel-iron, designed for mildly corrosive service**

The cast iron body and bonnet of this 125-lb gate valve contain 3 per cent nickel to provide an extra margin of corrosion resistance in many services. The trim, where corrosion is particularly damaging, is available in two highly corrosion-resistant alloys, 18–8 Mo stainless steel or all-monel. The valve is reported to be priced considerably lower than either all-stainless or all-monel valves, and lower than company's Causul metal valves which are designed to handle more severe corrosive conditions. The Lunkenheimer Co.

## 9—DISCONNECT SWITCHES

**Group-operated units are intended for outdoor service**

This new line of outdoor, group-operated disconnect switches is rated 7.5 through 69 kv, 400 and 600 amp. They are designed for pole or structure mounting in a horizontal, vertical or inverted position. Also available are manually op-



erated, interphase mechanism assemblies for direct or indirect connection.

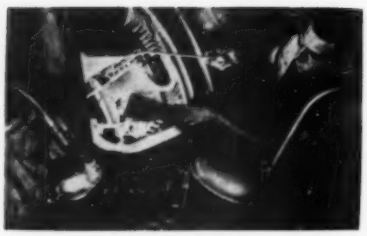
Features announced for these switches include silver-insert-to-silver-insert high pressure contacts; bearings and moving joints lubricated with silicone grease for life and sealed by silicone cord rings; rotating switch blades with powerful lever advantage to assure positive operation under ice or corrosive conditions; fewer current interchange points for cool operation; and adjustable terminal clamps that accommodate a wide range of conductor sizes.

The interphase mechanism assembly permits angular distortion of mounting structures, which, it is claimed, heretofore would have prevented this class of equipment from operating. The interphase mechanism can be field assembled prior to attachment to a switch. Line Material Co.

## 10—QUICK-DRYING SOLVENT

**For cleaning of wiring, fuses, motors, other electrical equipment**

Turco-Solv is said to combine the least toxic solvents available, consistent with safety from fire hazard. It is suggested



for in-plant maintenance cleaning of electrical equipment where a high-flash material is required, or for use in a whirl parts washer as a substitute for vapor degreasing or hand wiping.

According to manufacturer, Turco-Solv quickly removes deposits of grease, oil, metallic particles, carbon dust and other causes of flashovers. It is claimed to leave no oily residue and require no after-neutralization. Turco-Solv is announced as safe for use on all metal and wood surfaces, as well as well-bonded paint, and as having a tag closed cup flash point of over 200 F. Since it is non-conductive, Turco-Solv can be used to clean motors while they are hot, company says. It is applied by non-atomizing low pressure spray or brush. Turco Products, Inc.

## 11—SAFETY VALVE

**Designed to depressurize pressure vessels in event of an emergency**

Besides its depressurizing function, the new Remotor is also designed to serve as an "unloader" for applications where the unloading feature can be combined with a safety valve. In addition, the depressurizing component of the Remotor is interchangeable and can be mounted on manufacturer's other safety valves already installed. The new valve is said to operate efficiently under all conditions, including fire, freezing and current failure.

According to manufacturer, the Remotor offers the following features: operation by air pressure from remote points; rapid depressurizing of vessels in service to predetermined limit or to 0 psi; safety relief or drop-out service in one installation; extra power air motor, affording one regulated power supply for a series of valve installations. The Remotor is available with standard depressurizing motors in valve sizes from 1-by-1½ in. to 2½-by-4 in., and with extra-power depressurizing motors in valve sizes from 3-by-4 in. to 8-by-10 in. Specific application data is available. Farris Engineering Corp.

## 12 — ELECTRICAL CONDUIT

**Has outside surface especially resistant to corrosion**

Xduct Junior is an electrical metallic tubing with a bright outside surface said to offer unusual resistance to corrosion. According to manufacturer, an electro-galvanizing process utilized puts a uniform, unbroken zinc coating over the entire exterior of the tubing. A further process, which includes a brightening agent, adds to corrosion resistance and gives a metallic finish approaching stainless steel in appearance. The zinc coating, says company, adheres to the steel without flaking or cracking.

The inner surface, beyond the reach of tools and abrasive materials, has a baked-on covering of an aluminum enamel for minimum friction when fishing wires and cables through the electrical metallic tubing. The tubing is said to bend without excessive pressure and when properly bent, not to flatten or spring back. It comes in 10 ft lengths of standard diameters from ½ to 2 in. National Electric Products Corp.

## 13 — CLEANOUT MANOMETERS

**U type, for measuring pressure, vacuum and differential pressure**

Model BU Manometers have a glass U-tube with packings at top; and are available in eight sizes from 6 in. to 50 in. range. Model BS Manometers, having two straight glass tubes with packings at both ends and a cross connection in the lower head, are available in 13 sizes from 6 in. to 100 in. Tubes of both models are protected at sides and back by a rolled steel case of channel section. Connections are made to the upper head; and the removal of a single screw permits the case and glass tubing to be removed.

The manometers are obtainable with carbon steel heads (with Buna-N packing) and brass or stainless steel (with silicone rubber packing). Tubes are Pyrex glass. Scales are graduated in inches and tenths, having a simple zero adjustment. The upper head is tapped for ¼ in. pipe connections at each side. Although normally suspended from piping, unit can be mounted on a wall by screws through holes provided, and rear connections can be furnished. Details and prices are given in Bulletin 371. King Engineering Corp.

## 14—ELECTRICAL CONNECTOR

**Can be installed as a unit on transmission and distribution lines**

This corrosion-resistant, parallel groove connector for electrical lines is designed for installation as a unit. And accidental removal of the nut holding the assembly together is prevented by burring the end of its bolt, company points out — an advantage in installations high above the ground. According to company, the new fitting's hex nut is simply backed up a few turns and the assembly is slipped over the conductors. Then the

nut is tightened, locking the connector in place. The contact faces are claimed to accommodate over 100 combinations of copper, aluminum or ACSR conductor diameters ranging from No. 6 to 1/0 air-water-gas.

Corrosion-resisting properties of the connector are attributed to a silicon-aluminum alloy and a new surface treatment in which the assembly is dip-coated with an oxide-inhibiting seal. The coating on the fitting's contact surfaces is automatically removed during installation to provide a high conductivity joint, it is explained, because contact pressures up to 20,000 psi result when the hex nut is tightened. The ⅜-in. steel carriage bolt, lock washer and

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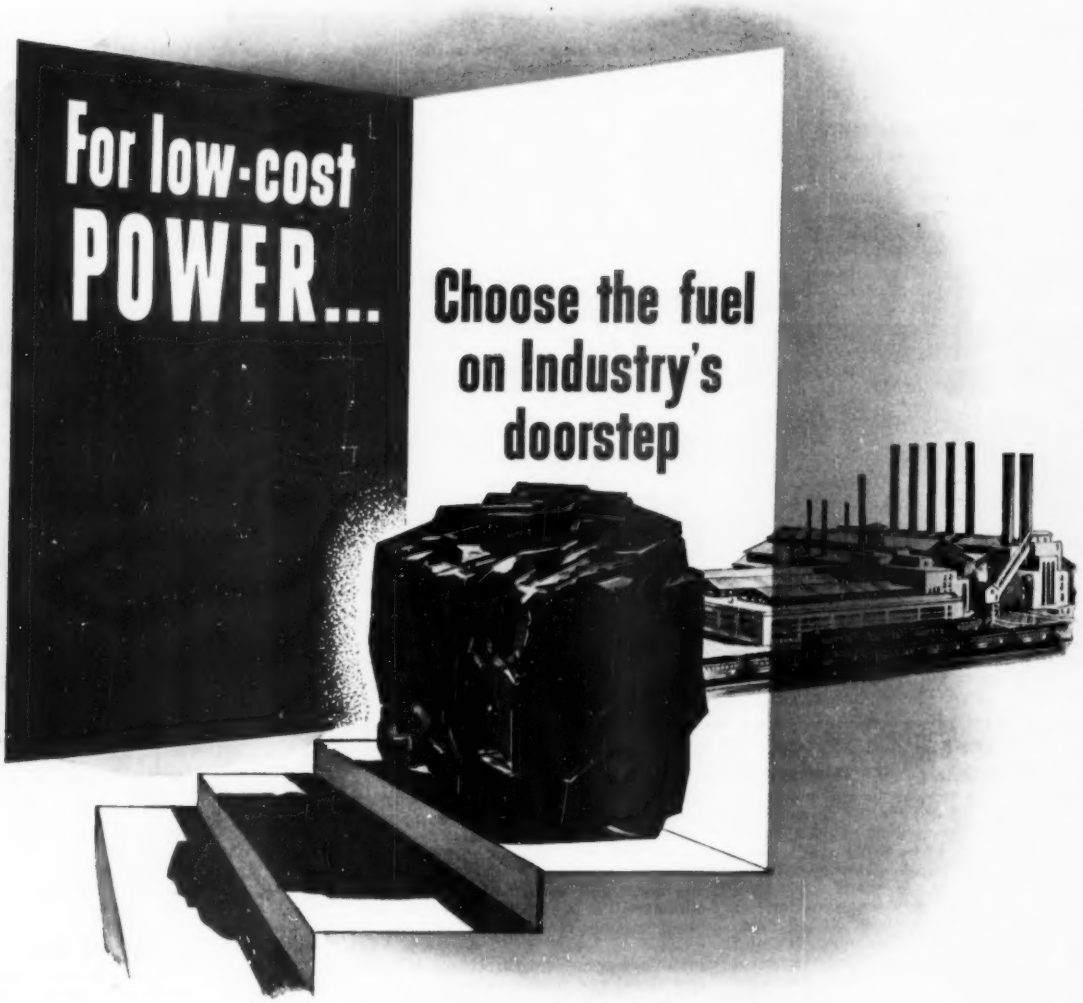

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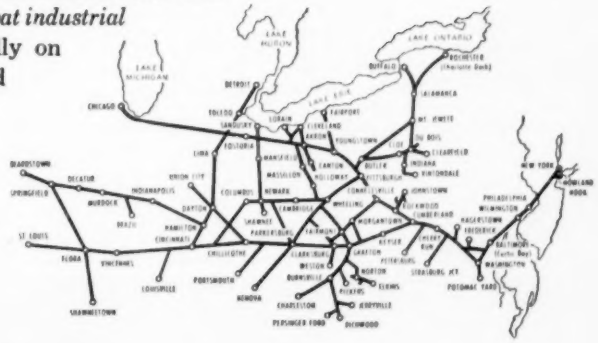

When you consider fuel, consider cost—dependability of service—*accessibility.* You'll choose the Bituminous mined on the B&O. For advice, *ask our man!*

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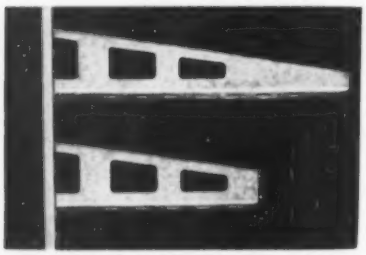
hex nut hold the identical fitting halves together; and a square shank, which fits into a similarly shaped hole, acts to prevent turning of the bolt in the fitting. The Thomas & Betts Co., Inc.

## 15—ONE-PIECE BRACKET

**Is quickly mounted holder for piping support system**

This new one-piece bracket is said to considerably reduce time required for installing this manufacturer's two-piece Rakit, a simplified supporting system, used in control stations, power plants and industrial applications. New sup-



ports can be placed securely into slotted vertical channel pieces by a twist of the wrist, it is pointed out, no fasteners being required. Rakit brochures are available in 3-, 7-, 13- and 19-in. lengths, and greater lengths can be obtained by the use of extenders. The Rakit Corp.

## 17—COMPRESSORS

**For air or gas, have sectionalized cylinder with valves in head**

The new Class ATH Air and Gas Compressors employ sectionalized cylinders arranged in three pieces and with inlet and discharge valves in the fronthead and backhead, and are equipped with cylinder liners. Some important advantages are said to result from this design. Since the cylinder is sectionalized and readily disassembled, the liner may be removed without disconnecting inlet or discharge air piping. This means that service problems involving piston rings, piston or liner, resolve into minor operations, manufacturer points out; and it facilitates thorough cleaning of cooling water passages.

Also, the valves in the heads allow better cooling, it is explained, and provide lower temperature throughout the cylinder and valves. Cooling jackets adjacent to cylinder heads are generous in size. This is important, says company, because the maximum temperature rise occurs at the end of the stroke adjacent to the cylinder heads, and the new design incorporates increased cooling surface where it is needed most. It also provides for cross-flow of cooling water, since it is admitted on the lower side of one head, and discharged from the upper side of the other. These compressors are now available in the single stage 100 psig discharge pressure sizes. Pennsylvania Pump & Compressor Co.

## 16—POLYPHASE A-C MOTORS IN NEMA FRAMES

**Designed for greater efficiency, quieter operation and more protection**

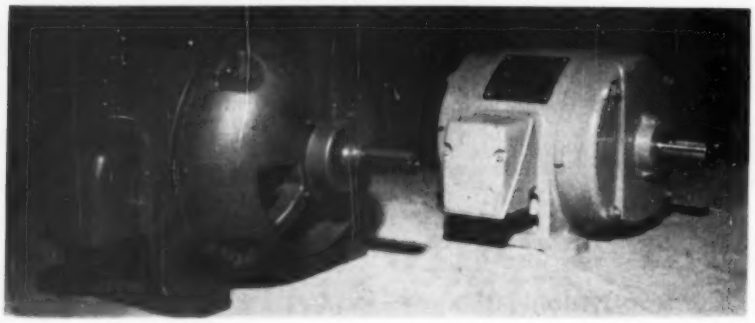
Polyphase a-c motors in the new Tri-Clad 55 line are designed to do a better job of protecting against physical damage, electrical breakdown and operating wear. Built in accordance with revised NEMA frame standards, they retain the cast iron construction of manufacturer's previous Tri-Clad models, but are made of new materials and offer new advantages. They are better protected, lighter in weight and smaller in size. They are said to feature an average size reduction of 50 per cent by volume and 22 per cent less weight per horsepower. A new 1½ hp drip-proof model is shown at right below, with a former 1½ hp model.

The new Tri-Clad 55 design incorporates a new insulation system, bearing assembly and ventilation plan. Keystone of the insulation system is a polyester film claimed to be eight times as strong as the previously used materials. It is used on phases and slot tubes, where motor wear is severe. This synthetic material is used in combination with company's Formex wire, improved Glyptal varnish and silicone Dri-film dip.

The new bearing assembly is more tightly sealed and is lubricated by a grease said to greatly outlast the lubricants previously used. A double-end ventilation system serves to cool the motor uniformly. Also, larger rotor fans increase the cooling air flow through the motor and dissipate rotor heat more effectively, it is explained. On the drip-proof models, protection has been increased as much as 60 per cent, says manufacturer, through the use of a new end shield and frame design.

In the totally-enclosed fan-cooled models, electrical parts are enclosed by tightly-sealed cast-iron frame and end shields, a compression fit lead seal, and a rotating labyrinth seal on the shaft. A "jet" ventilating system is used.

A major feature of the Tri-Clad 55 is quieter operation; the noise level of the new 10 hp model is said to be as low as the former 2 hp size. It is pointed out that although smaller and lighter than their predecessors, the Tri-Clad 55 models carry higher full load speed ratings. After the first of the year these motors will be available in the 182 and 184 frame sizes (1, 1½ and 2 hp at 1800 rpm) in horizontal drip-proof and totally enclosed fan-cooled models, as well as in gear-motors. General Electric Co.



**You may use the post cards on pages 35 and 133 to ask for further information on any of these new products**

## 18—DRAWING INSTRUMENT

**Does a variety of jobs and leaves one hand free for drawing**

A versatile new transparent instrument, the Glide-Rule is capable of rolling in two directions. It is designed to combine several engineer's tools in one — triangles, T-square, straight edge, scales, protractor, and parallel rules — to serve as a "pocket-portable" drafting machine. Only 2½ in. by 9 in., the instrument has four drawing edges with scales in 16ths and 20ths, and protractor with emphasized 30-, 45-, 60-deg angles.

The operation of the Glide-Rule leaves one hand free. The instrument

rolls both up and down and right and left, and a small thumb button lets the user change direction and roll the Glide-Rule to the desired position. The professional model of the Glide-Rule costs less than $4.00; a student model costs less than $3.00. Smith Drake Corp.

## 19 — BOILER-BURNER UNIT

**For high or low pressure heating, or for power and process steam**

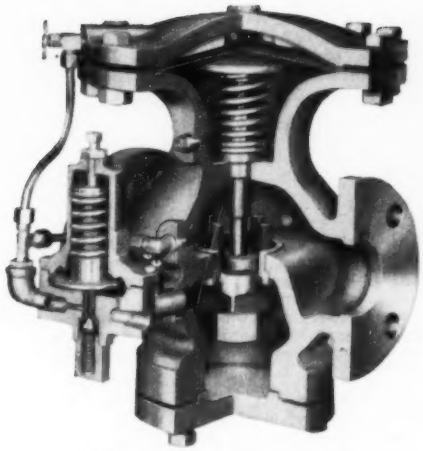
This packaged unit operates on oil, gas, or oil and gas combination. It is shipped ready for operation as soon as fuel and service connections are made. Of ASME construction, the boiler is designed with large furnace volume for lower heat release, with proportional longer service life. Tubes are arranged in staggered rows so that release of steam from tube walls is speeded by a wiping action to increase efficiency of heat transfer. Other boiler features include ample openings for ease of access, and davit flue-door suspension for easy one-man operation.

The automatically-controlled burner unit has a turndown of 5 to 1, and is said to operate at over 80 per cent efficiency through its entire modulating range. A volumetric oil control meters the quantity needed for varying loads, and an automatic oil heating system keeps heavy oil at correct temperature and viscosity. The entire boiler-burner unit is sealed for operation at higher than atmospheric pressure.

The unit is supplied in two basic types: power units, in capacity range from 37 hp to 363 hp at normal SBI rating; and heating boilers, in sizes from 4250 lb EDR to 42,500 lb EDR at normal SBI steam ratings. The units incorporate boilers designed by Titusville Iron Works, and Iron Fireman burners. Bulletin B-3133 describes these units. Iron Fireman Mfg. Co.

# Men Who Know Plant Engineering

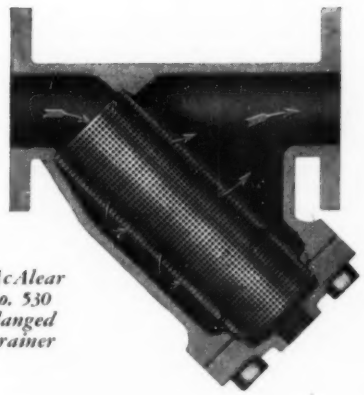
## KNOW THE VALUE OF EXPERIENCE AND ENGINEERING "KNOW-HOW"



*McAlear 228 Pilot-Operated Pressure Reducing Valve*

**Behind each unit of McAlear control equipment is a half-century of specialized engineering experience reflected in an enviable reputation of dependable service!**

**The No. 228 Pilot-Operated Pressure Reducing Valve (left) is accurately sensitive and dependable where positive and automatic control of reduced pressure is required in steam service.**



*McAlear No. 530 Flanged Strainer*

McAlear strainers are recommended for all control valves, regulators, automatic trap installations and other uses where grit and scale are present. They are furnished for any purpose . . . "Y" and basket type construction . . . ½ to 24 inch size range.

***Write today for our bulletin No. 228 and No. 128A covering the Pilot Operated Pressure Reducing Valve and McAlear Strainers***

**McALEAR MANUFACTURING CO.**
**1901-1919 SOUTH WESTERN AVE.**
**CHICAGO 8, ILL., U.S.A.**

McALEAR
PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE
controls
for STEAM, WATER, AIR, OIL and GAS

For more data circle 537 on Post Card

# POWER PLANT Construction News

**El Centro, Calif.** — Board of Directors, Imperial Irrigation District, El Centro, has plans maturing for proposed new hydroelectric generating station at Pilot Knob, on All-American Canal, including power dam, hydraulic turbines and generators, with rating of 33,000-kw, and auxiliary equipment, previously noted in these columns. It is estimated to cost about $6,500,000. Work scheduled to begin early in 1954.

**El Segundo, Calif.** — Southern California Edison Co., 601 W. Fifth St., Los Angeles, has authorized immediate construction of proposed new steam-electric generating plant near El Segundo, previously referred to in these columns. Station will be of outdoor type, with initial installation of a 156,000-kw generator unit and auxiliaries, high-pressure boilers and accessory equipment. Petroleum pitch, a crude oil derivative, will be used as fuel. Plant has been designed for installation of a second generating unit, of similar rating, at later date. Initial station is scheduled for completion in summer of 1955. Cost reported over $40,000,000.

**Devon, Conn.** — Connecticut Light & Power Co., Hartford, Conn., has plans for expansion in power plant at Devon, to be equipped for increased capacity. No official estimate of cost announced. Contract is being awarded for structural steel framing and work will proceed on superstructure in near future.

**Jacksonville, Fla.** — Municipal Electric Department, foot of Laura St., has plans for expansion and improvements in municipal steam-electric generating station, with installation of additional equipment. Cost reported in excess of $2,500,000. Program scheduled to be carried out at early date.

**Douglas, Ga.** — C. O. Smith Guano Co., Moultrie, Ga., commercial fertilizers, plans boiler house at proposed new plant at Douglas, to be one-story, about 65,000 sq ft floor space. Entire project reported to cost over $175,000.

**Wichita, Kan.** — Kansas Gas & Electric Co., 201 N. Market St., has disposed of a bond and preferred stock issue, to total about $15,000,000, proceeds to be used for expansion and improvements in generating facilities, power substations, transmission lines and the like, including completion of new steam-electric generating station on Neosho River, Pittsburg, Kan., now in course of construction. It will have an initial rating of 70,000-kw.

**Marquette, Mich.** — Upper Peninsular Generating Co., 16 Sheldon Ave., Houghton, Mich., recently organized by J. H. Warden, president, and associates, has acquired certain properties of Cliffs Power & Light Co., with plants at Marquette and Ishpeming, Mich., an interest of Cleveland Cliffs Iron Co., last noted place, with headquarters in Union Commerce Bldg., Cleveland, Ohio. Upper Peninsular company will be affiliated with Cleveland Cliffs and has plans in progress for new steam-electric generating plant at Marquette, with initial capacity of about 22,000-kw, reported to cost close to $7,500,000. Work scheduled to begin early in 1954. Large part of output will be used by Cleveland Cliffs company at iron ore mining properties in area noted.

**Columbia, Mo.** — Water & Light Department has plans under way for extensions and improvements in municipal steam-electric generating plant, with installation of new 10,000-kw turbine-generator unit, high-pressure boiler and auxiliary equipment. Cost reported about $1,160,000. Bids are expected to be asked soon. Preliminary plans also are being considered for a new municipal power plant, with initial rating of about 15,000-kw, estimated to cost over $6,000,000. Lutz & May, Finance Bldg., Kansas City, Mo., are consulting engineers.

**Grand Island, Neb.** — Water & Light Department, 102 W. Second St., has plans under way for extensions and improvements in municipal steam-electric generating plant, with installation of new turbine-generator unit, high-pressure boiler and accessory equipment. Cost reported close to $2,500,000. Lutz & May, Finance Bldg., Kansas City, Mo., are consulting engineers.

**Portsmouth, N. H.** — Public Service Co. of New Hampshire, Manchester, has approved plans for expansion in Mercury steam-electric generating plant near Portsmouth, with installation of a 40,000-kw turbine-generator unit, high-pressure boilers and auxiliary equipment. Work is scheduled to begin at once on foundations, with completion of unit in fall of 1955. Cost about $8,000,000. Construction contract has been let to Standard Construction Co., Portland, Me.

**Roanoke Rapids, N. C.** — Virginia Electric & Power Co., 17th and Franklin Sts., Richmond, Va., will have plans prepared by Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., consulting engineer, for proposed new hydroelectric generating station on Roanoke River, near Roanoke Rapids, recently noted in these columns. It will be equipped with hydraulic turbines and electric generators for initial rating of 100,000-kw. Work is scheduled to proceed at early date.

**Morristown, N. J.** — Plax Corp., 672 Farmington Ave., West Hartford, Conn., plastic products, is considering construction of boiler house at proposed new plant on Hanover Ave., Morris Township, near Morristown, where tract of about 12 acres of land is being acquired. Entire project reported to cost about $800,000. Work is scheduled to begin in 1954.

**Ashtabula, Ohio** — Archer-Daniels-Midland Co., Roanoke Bldg., Minneapolis, Minn., linseed oils, hydrogenerated fats and oils, chemical products, plans steam power house at new plant at Ashtabula, where tract of 40 acres of land has been acquired. It will consist of several large one and multi-story units for production of a line of unsaturated higher alcohols, and is reported to cost over $7,000,000. Work on superstructure will begin soon.

**Columbus, Ohio** — Columbus & Southern Ohio Electric Co., 215 N. Front St., will proceed with expansion in local Picway steam-electric generating plant near city, previously noted in these columns, with installation of new turbine-generator unit, with rating of 100,000-kw, high-pressure boilers and auxiliary equipment. Proposed to have expansion program completed in about 24 months. Cost reported close to $15,000,000.

**Columbus, Ohio** — Simmons Co., Kenosha, Wis., mattresses and other bedding products, is considering steam power house at proposed new branch plant at Columbus, where site is being acquired. It will consist of a main one and multi-story building, equipped for large output. Cost reported about $3,000,000.

**Exton, Pa.** — White Motor Co., E. 79th St. and Wallace Ave., Cleveland, Ohio, motor trucks and parts, plans steam power house at new branch plant at Eston, where large tract of land has been acquired. It will comprise a main one-story building and auxiliary structures, approximating 130,000 sq ft floor space, and will be used for production for Autocar Division, replacing present plant of that company at Ardmore, Pa. Work will proceed at once, with completion scheduled in 1954. Cost reported over $2,000,000.

**Providence, R. I.** — Narragansett Electric Co., 51 Westminster St., has concluded arrangements for purchase of tract of about 90 acres of land at Rome Point, North Kingstown District, and will use as site for new generating station. Plant will have an initial capacity of 250,000-kw, divided into two 125,000-kw turbine-generators, with battery of high-pressure boilers and auxiliary equipment. Cost estimated about $15,000,000. Plant will be designed to accommodate six additional generators in future. Program is in a preliminary stage and time of construction is still to be determined.

**Pettus, Tex.** — Danaho Refining Co., Inc., City National Bank Bldg., Houston, Tex., plans expansion in steam power house at refinery at Pettus, in connection with an expansion and modernization program to increase output of high-octane aviation gasoline and other oil products. Entire program reported to cost about $2,500,000. Koch Engineering Co., Inc., 321 W. Douglas St., Wichita, Kans., is engineer.

**San Antonio, Tex.** — San Antonio Public Service Board, 201 N. St. Marys St., has engaged Gibbs & Hill, Inc., Pennsylvania Station, New York, N. Y., consulting engineer, to prepare plans for proposed new municipal steam-electric power plant, recently referred to in these columns. It will be equipped for an initial capacity of 100,000-kw, and is estimated to cost approximately $11,500,000, instead of smaller sum previously reported. Bids are expected to be asked in near future.

**Victoria, Tex.** — Central Power & Light Co. has approved plans for expansion and improvements in steam-electric generating plant at Victoria, with installation of new turbine-generator unit and auxiliary equipment. No estimate of cost announced. Work on foundations will be placed under way at early date.

**Salt Lake City, Utah** — Mill Creek Chemical Co., Salt Lake City, recently organized, care of Tears Engineers, 4617 Cole Ave., Dallas, Tex., consulting engineer, plans steam power house at new plant near Salt Lake City for processing and production of anhydrous ammonia. It will comprise several production units, with entire project estimated to cost over $8,000,000. Work scheduled to begin soon.

**Salt Lake City, Utah** — Sure Seal Corp., 1449 East 3350 So., plans steam-generating station at new wax refining plant on 20-acre tract of land near city. Refinery will comprise several units, equipped for large capacity. Cost reported about $2,000,000.

# Let's take a CLOSER LOOK at CAUSES OF TUBE FAILURES

Tubes are critical materials. Peak production of petroleum products is vital to the defense program. These are two urgent reasons for giving extraordinary attention *now* to getting optimum failure-free service from tube installations in petro-chemical facilities.

Of major importance in securing best operating results is an understanding of the numerous factors affecting tube life in high pressure, high temperature applications. Innumerable investigations of tube failures in such service over a 25-year period show that they are most frequently caused by circumstances other than actual physical defects in the tubes themselves. By far the most common causes of failures are overheating, excessive pressures, corrosion, and scaling due to tubes being subjected to improper operating conditions.

Enumerated are some of the more prevalent reasons, based on extensive studies, that account for excessive tube temperatures and attendant failures in chemical and petroleum conversion equipment. These are presented in the hope they will aid engineers and operating personnel to get better-than-ever service from their tube installations.

Through Mr. Tubes—your local B&W Tube Representative—is available a wealth of data on the behavior of tubing steels under conditions embraced in modern processing plants. It may pay you as it has so many others to call on this vast source of useful information.

## Some Common Causes of Reduced Tube Life and Increased Maintenance

1. Excessive transfer rates in furnace equipment.
2. Coking of tubes — either expected or extraordinary.
3. Failure to clean tubes at regularly scheduled periods.
4. Unexpected radiation from bridge wall or refractory surfaces.
5. Improperly calibrated fuel meters on burner equipment.
6. Increase of product temperature over a safe design limit.
7. Unequal heating around circumference or along tube length.
8. Excessive furnace temperatures.
9. Guessing at tube metal temperatures.
10. Increase of pump pressure of maintain through-put.
11. Abuse during mechanical decoking, or scaling during burningout operations.
12. Improper supports resulting in bending or sagging.
13. Lack of control of furnace atmosphere to retard scaling.
14. Corrosion of ends or body of tube or both.
15. Carburization and exfoliation of carburized layer.
16. Abrasion or erosion due to coke in fluid stream.
17. Leaky header seats.

*Bulletin TR-516 entitled "Some Experiences in Service", contains more detailed information on this timely subject, and is available upon request.*

**THE BABCOCK & WILCOX COMPANY**
***TUBULAR PRODUCTS DIVISION***
***General Offices & Plants***
**Beaver Fall, Pa.—Seamless Tubing; Welded Stainless Steel Tubing**
**Alliance, Ohio—Welded Carbon Steel Tubing**

*Sales Offices:* Beaver Falls, Pa. • Boston 16, Mass. • Chicago 3, Ill. • Cleveland 14, Ohio • Denver 4, Colo. • Detroit 26, Mich. • Houston 19, Texas • Los Angeles 17, Cal. • New York 16, N. Y. Philadelphia 2, Pa. • St. Louis 1, Mo. • San Francisco 3, Cal. • Syracuse 2, N. Y. • Toronto, Ontario Tulsa 3, Okla.

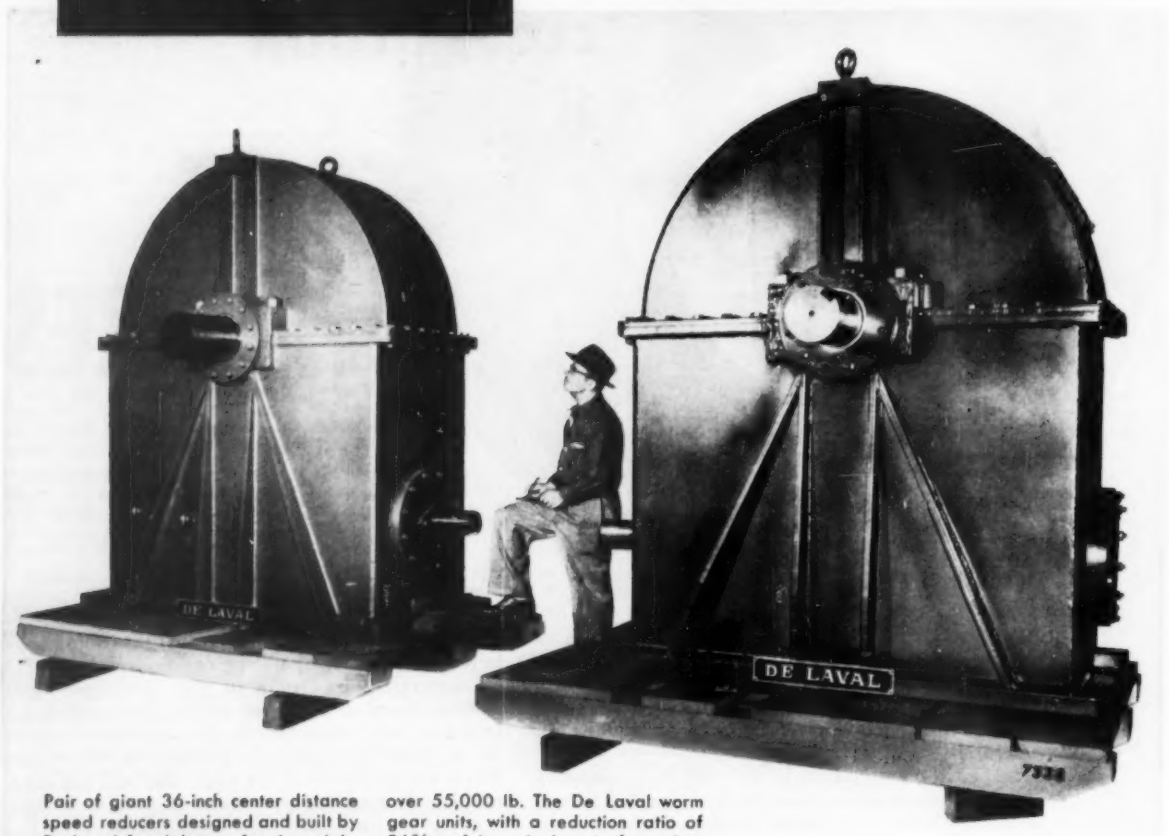
B&W SEAMLESS and WELDED TUBES

TA-1737(F)

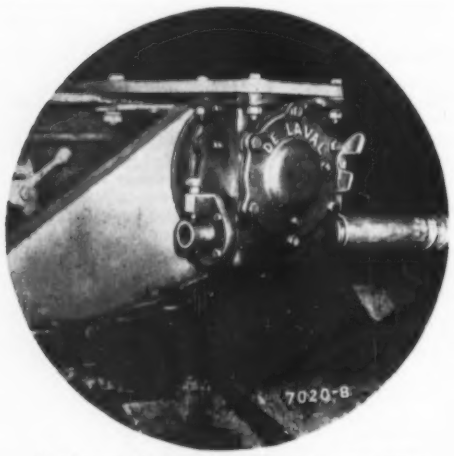
**For more data circle 538 on Post Card**

# DE LAVAL
## SPEED REDUCERS

# *from dwarf to giant size*




Pair of giant 36-inch center distance speed reducers designed and built by De Laval for slab transfers in a slabbing-blooming mill. These slab transfers are used to convey steel slabs up to 12 in. thick and 42 in. wide, weighing over 55,000 lb. The De Laval worm gear units, with a reduction ratio of 26⅔ to 1 in a single set of gearing, are each driven by a 200 hp, 410 rpm motor coupled directly to the input shafts of the slab transfers.




Here's one of the smaller De Laval worm gear speed reducers with a 3″ center distance being used for a new coal drilling machine.

De Laval heavy-duty worm gear speed reducers seldom require attention under the most rugged operating conditions. They make a quiet, close-couple compact drive. They permit high ratio reductions in a minimum of space and withstand severe shock loads without damage. De Laval builds all sizes from 3″ to 36″ center distances for transmission ratios of 3.1:1 to 100:1 in single reduction units and ratios of 50:1 to 8000:1 in double reduction units. Whether you need dwarf or giant worm gearing, consult De Laval for engineering assistance. *Send for De Laval Manuals G-WBV and G-WWH containing data on single and double reduction units.*

**DE LAVAL** *Speed Reducers*

DE LAVAL STEAM TURBINE COMPANY
*816 Nottingham Way, Trenton 2, New Jersey*

DL-210

**For more data circle 526 on Post Card**

# Con Edison specifies "K" Monel pump shafts for New Astoria Station

At their first all-new plant in 25 years, the Consolidated Edison Company means to take no chances with pump shaft trouble.

The Astoria Station, now under construction at the edge of New York's East River, has four single-stage vertical mixed flow pumps (each with a capacity of 68,500 gpm) to circulate water for its condensers. Made by Economy Pump Division of H. C. Wheeler Manufacturing Company, *all four pumps have "K" Monel shafts, as specified by Con Edison engineers.*

They singled out this rugged shafting material for several important reasons. For one thing, they knew "K" Monel offered them excellent resistance to corrosion. This was a basic need, for water drawn from the brackish, sewage-polluted East River is highly corrosive.

They wanted, too, a shaft metal that had great strength and hardness, and high resistance to corrosion fatigue.

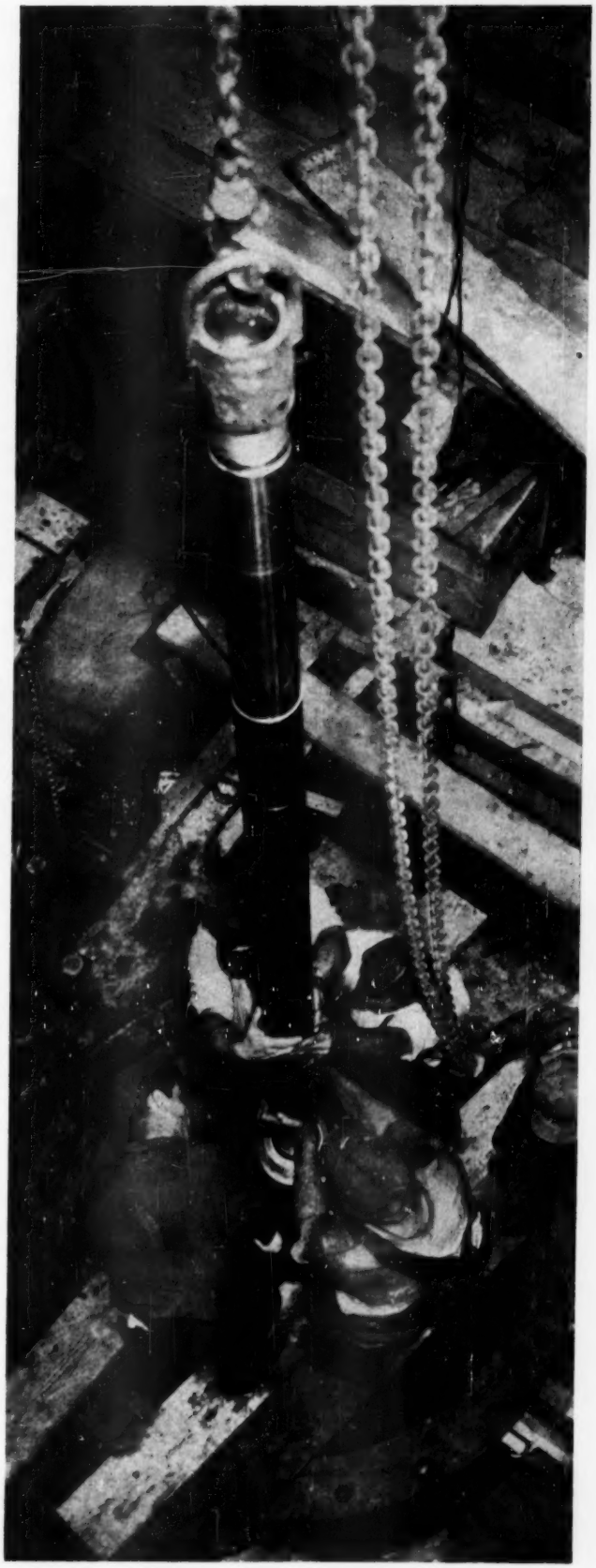
"K" Monel meets all these requirements. And it has the additional advantage of being heat-treatable *after* machining without undue distortion.

There's valuable information for pump users in our booklet, "*How to get longer service from your pumps.*" A copy belongs on the desk of every man concerned with the operation, maintenance or purchase of pumping equipment. The booklet will be sent promptly — without cost or obligation. Write for it — *today.*

**THE INTERNATIONAL NICKEL COMPANY, INC.**
67 Wall Street New York 5, N. Y.

## Inco Nickel Alloys INCO

**MONEL® • "R"® MONEL • "K"® MONEL**
**"KR"® MONEL • "S"® MONEL • INCONEL®**
**INCONEL "X"® • INCONEL "W"® • INCOLOY®**
**NIMONIC® Alloys • NICKEL • LOW CARBON NICKEL**
**DURANICKEL®**



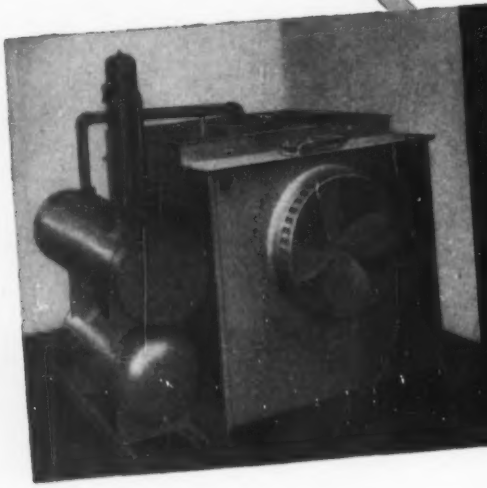
**One of four.** Workmen lower a "K" Monel shaft into a giant SAFV Wheeler-Economy pump at Con Edison's new station in Astoria, N. Y. This shaft is 6 inches in diameter, 27½ feet long, and weighs 1,900 pounds. It has a minimum Brinell hardness of 265. In operation, the pump, with a total dynamic head of 16 feet, will be driven at 233 rpm by a 400-hp motor.

**For more data circle 539 on Post Card**

# New

## SAVES WATER and CUTS MAINTENANCE COSTS . . .

*Illustrations show two views of a 35 ton Condenser Tower prior to partial disassembly for shipment.*



# Vogt

## CONDENSER TOWER

FOR CONDENSING REFRIGERANTS

### SINGLE RESPONSIBILITY:

Vogt, leading builder of refrigeration condensers, assumes responsibility for engineering the unit. Only one purchase order needed.

### SHOP FITTED:

To cut down field assembly labor. Requires no cutting or fitting of pipe.

Designed for today's water conservation requirements, and to keep refrigeration costs low, the *new* Vogt Condenser Tower meets the need for a proven, readily cleanable condensing unit.

The Vogt Condenser Tower consists of a multipass straight tube condenser, a receiver, an oil trap, a cooling tower, and a water pump. Removable cast iron heads permit easy cleaning of the condenser tubes.

Water costs are extremely low since the cooling water is recirculated continuously and requires only a small amount of makeup to replace losses due to windage and evaporation.

Condenser Tower units are available in capacities ranging from 5 to 50 tons refrigeration. Additional information will be furnished upon request.

**HENRY VOGT MACHINE CO., Louisville 10, Kentucky**

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

**For more data circle 540 on Post Card**

# Fully Crowned Tooth Design Can Be Used To Solve Your Long-Standing Coupling Problem

A major improvement in gearing for power transmission—a fundamental improvement in gear tooth design that practically eliminates all "end tooth and tip" contact and provides greater freedom of axial movement distinguishes Amerigear Couplings from common gear-type couplings. Amerigear Couplings offer many more advantages than are obtainable with the common basic designs. The Amerigear Crowned Tooth Design can be applied wherever couplings are required. There are many instances where this design has been utilized to simplify power transmission mechanisms and add reliability to their performance in a measure heretofore found impossible.

If your problem arises from excessive offset or angular misalignment, tight back lash requirement, space limitations, high speeds and loads, or any combination of these, the solution is best made by the utilization of the Amerigear Fully Crowned Tooth. Amerigear engineers are available for consultation.

**AMERICAN FLEXIBLE COUPLING COMPANY**
ERIE, PA., U. S. A.
Originator of the Amerigear Fully Crowned Tooth
Sales Offices in Principal Industrial Centers
Affiliate J. A. ZURN MFG. CO.
In Canada: CANADIAN ZURN ENGINEERING, LTD.
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Amerigear
Fully Crowned Tooth Design Solves Wide Range of Power Transmission Problems.
Crowned Tip Contacts Root of Internal Gear Tooth in Sleeve, Accurately Piloting Sleeve With a Pull and Socket Action.
Amerigear*
*Trade Mark Reg.
THE ONLY GEAR TYPE COUPLING WITH FULLY CROWNED TEETH
Oil Seals of Amerigear Couplings Are As Advanced In Design, Performance, And Effectiveness As Is The Amerigear Fully Crowned Tooth. Pat. & Pat. Pending
Clearance to Eliminate Interference with Sleeve of Tooth Fillet and Allow Contact on True Flank of Gear Teeth.
Crowned Flank Carries All the Load and Provides for Correction of Lateral and Angular Misalignments When Required.
Are manufacturers of the original "Oldham Type" American Flexible Coupling

Comparison Of Amerigear Fully Crowned Tooth Design With Gearing Of Conventional Gear-Type Couplings Shows How "End Tooth And Tip" Contact Is Practically Eliminated And Why Greater Freedom Of Axial Movement Is Provided By Amerigear Fully Crowned Tooth Design (dotted lines indicate gear teeth of conventional gear-type coupling).

Copyright 1953



**AMERICAN FLEXIBLE COUPLING COMPANY**
ERIE, PA., U. S. A.

Please send me further information regarding AMERIGEAR COUPLINGS with the fully Crowned Teeth and Catalog No. 501.

Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

Please attach to your business letterhead

For more data circle 541 on Post Card

*Doing a big job . .*

HAGAN

automatic combustion controls

and HAGAN

ring balance instruments

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AUTOMOTIVE AND
AERONAUTICAL TESTING FACILITIES

HAGAN
HALL
BUROMIN
CALGON

# *and doing it right*

This simply means that the Hagan Combustion Control and Instrumentation System is maintaining optimum steam plant operating efficiency, with a minimum of operator attention and minimum maintenance costs.

That Hagan Systems are "Doing It Right" is amply demonstrated by their use in steam plants of all sizes and types, all over the world. Further proof of top performance can be found in the number of Hagan-equipped plants where the operators have repeatedly specified Hagan equipment for plant expansion or new facilities.

This record of enthusiastic approval of Hagan systems is traceable to the three basic considerations which govern the design of every Hagan system . . .

**accuracy**

. . . every unit used in a Hagan Combustion Control and Instrumentation System is designed for the highest possible accuracy, and is selected primarily to be an integrated part of a system built for a specific set of operating conditions.

**dependability**

. . . sound design and sturdy construction guarantee dependability in Hagan Systems. Many plants, originally equipped by Hagan twenty or thirty years ago, are still operating efficiently with the same durable Hagan Automatic Combustion Controls.

**versatility**

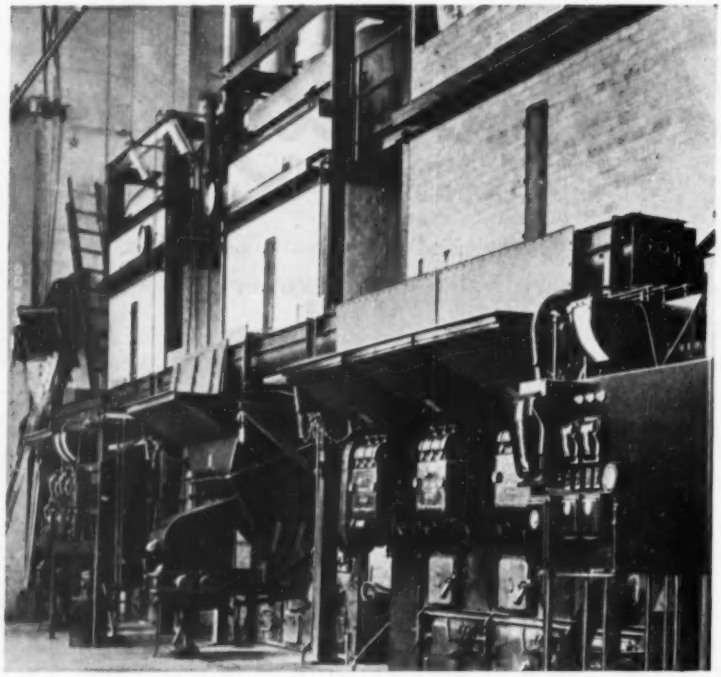
. . . Hagan has kept pace with the new demands being made on boilers—higher temperatures and pressures, multiple fuel systems, widely fluctuating demand. Whatever the requirements of your plant, there is a Hagan System of Automatic Combustion Control and Instrumentation to fit.

## HAGAN CORPORATION

**Hagan Building Pittsburgh 30, Pennsylvania**

For more data circle 592 on Post Card

# WHY EUCLID SWITCHED TO COAL!



**"We cut costs and provided our expanding plant with a flexible heating system by burning coal instead of gas,"**

**says D. L. Lawrence, Plant Engineer**
**The Euclid Road Machinery Co.**
**Cleveland, Ohio**

"Upon expanding our St. Clair Plant, we found we could save money by replacing our gas-fired heating system with a modern coal-burning installation. After we made this change, our plant again doubled in size. Yet the stoker-fed boilers shown on the left continued to supply all our heating needs."

*Additional case histories, showing how other types of plants save money by burning coal with modern equipment, are available upon request.*

**What does it cost you to operate your steam plant?**

Chances are that, unless you've modernized in the past few years, you could reduce that cost substantially with modern, bituminous coal-burning equipment.

Modern combustion equipment can give you 10% to 40% more steam from a ton of coal. Up-to-date coal and ash handling equipment can cut your labor costs and provide you with a clean, convenient, dust-free operation.

And with bituminous coal, you will continue to enjoy these advantages for years and years.

**If you operate a steam plant, you can't afford to ignore these facts!**

**BITUMINOUS COAL** in most places is today's lowest-cost fuel, and coal reserves in America are adequate for hundreds of years to come.

**COAL** production in the U.S.A. is highly mechanized and by far the most efficient in the world.

**COAL** prices will therefore remain the most stable of all fuels.

**COAL** is the safest fuel to store and use.

**COAL** is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

**BITUMINOUS COAL INSTITUTE**

**A Department of National Coal Association**
**Southern Building, Washington 5, D. C.**

*FOR HIGH EFFICIENCY FOR LOW COST*

# YOU CAN COUNT ON COAL!

**For more data circle 509 on Post Card**

STANDARD HD
TRADE MARK
OIL

# 21,000 hours young!

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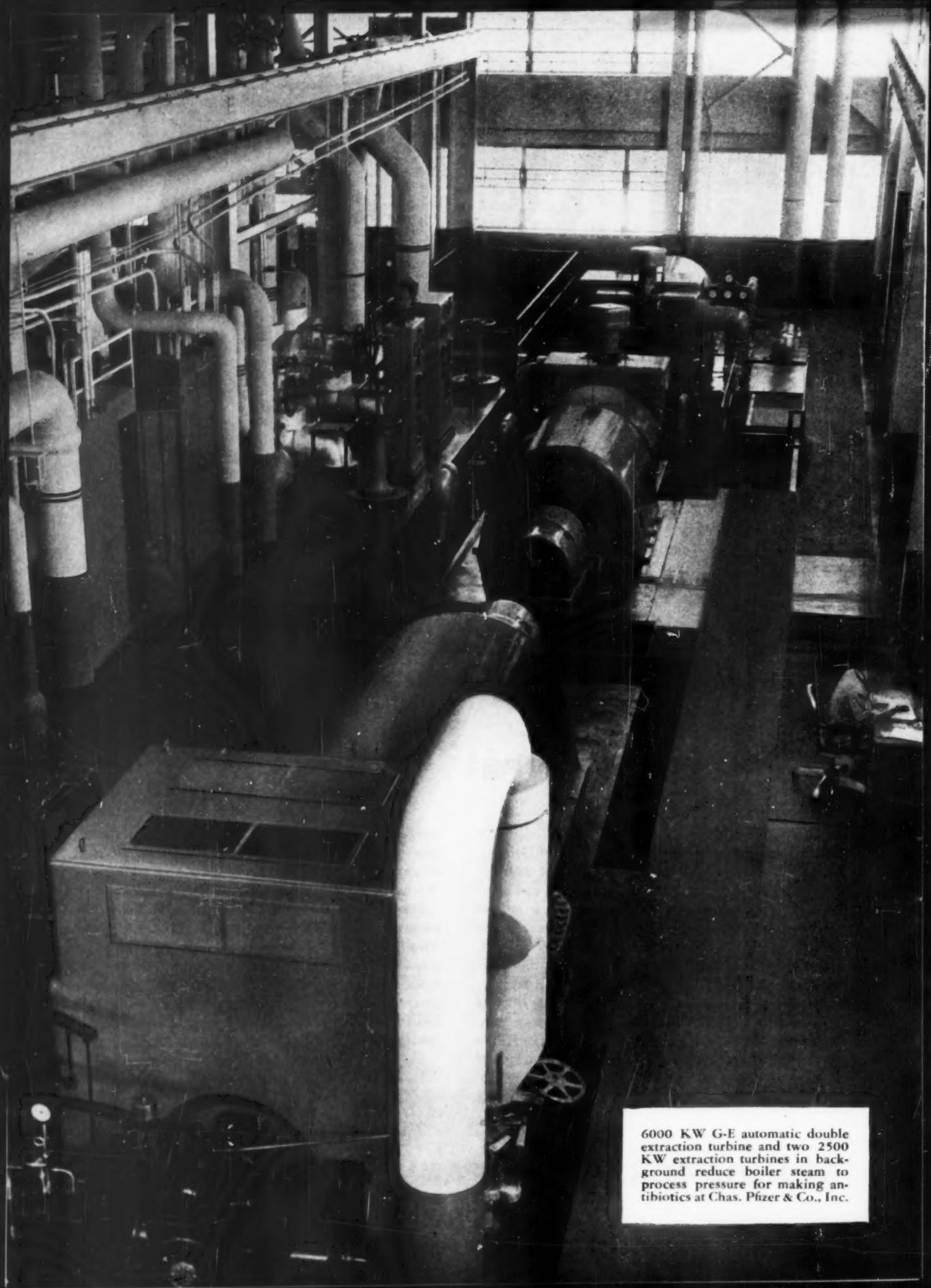

6000 KW G-E automatic double extraction turbine and two 2500 KW extraction turbines in background reduce boiler steam to process pressure for making antibiotics at Chas. Pfizer & Co., Inc.

# G-E Extraction Turbine at Chas. Pfizer & Co., Inc. Increases Plant Thermal Efficiency Over 15%

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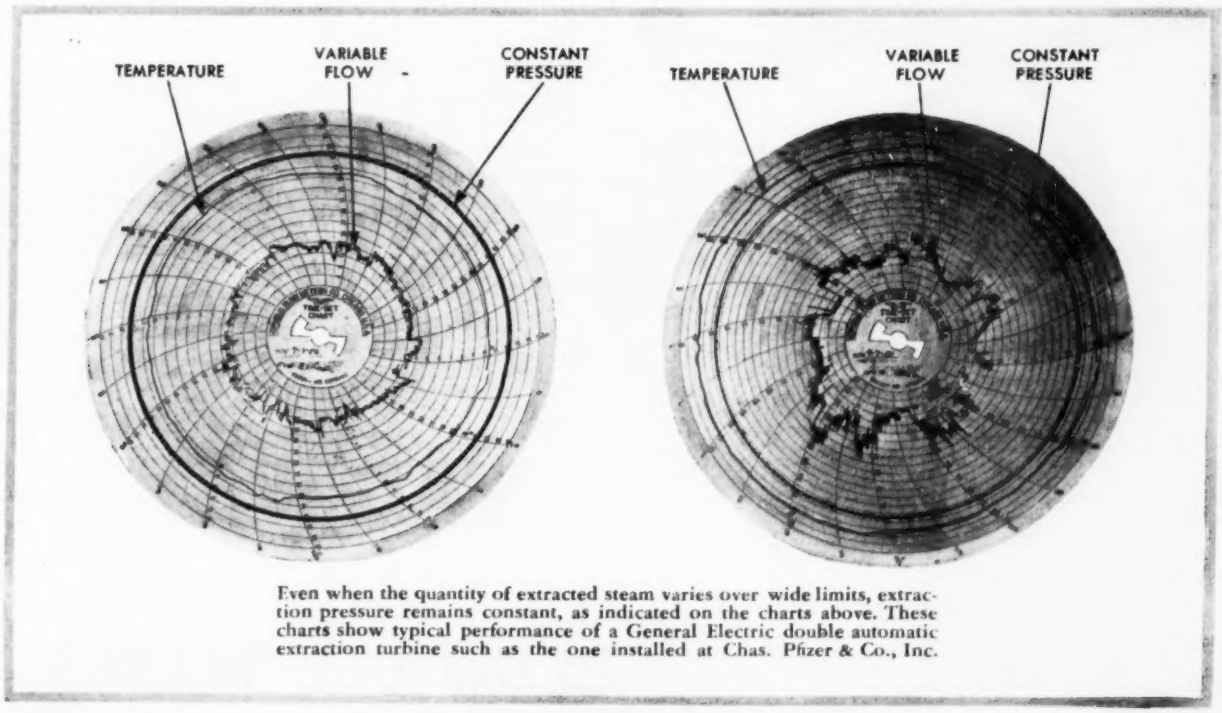
# GENERAL ELECTRIC




Even when the quantity of extracted steam varies over wide limits, extraction pressure remains constant, as indicated on the charts above. These charts show typical performance of a General Electric double automatic extraction turbine such as the one installed at Chas. Pfizer & Co., Inc.

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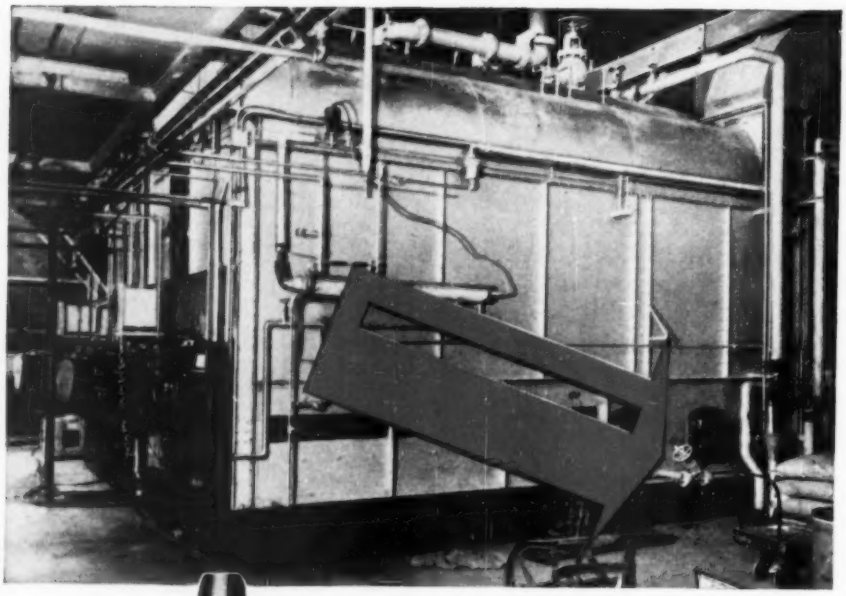
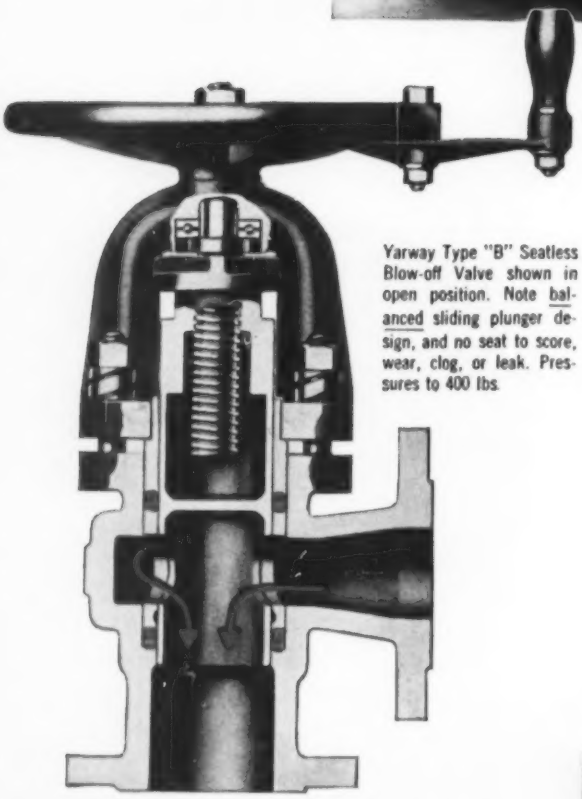
# THIS ERIE CITY "PACKAGE" INCLUDES A YARWAY SEATLESS





Yarway Type "B" Seatless Blow-off Valve shown in open position. Note balanced sliding plunger design, and no seat to score, wear, clog, or leak. Pressures to 400 lbs.

■ The above installation of two 300 hp. Erie City VL type boilers at a Detroit automotive plant shows Yarway Seatless Blow-off Valves as part of the "package" picture.

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## SEATLESS BLOW-OFF VALVES

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# Don't Blame Idle Distribution Transformers for Your Bad PF

**Author maintains that idle distribution transformers do not deserve their bad reputation for lowering system power factor and quotes evidence to support his view**

By **ROBERT S. HORN**

Electrical Engineer, U. S. Navy Department, Guam

THERE APPEARS to be a generally accepted misconception about the bad effect idle transformers have on the power factor of a distribution system. As a result, the following has been prepared on the assumption that it will interest those concerned with the subject.

Presence of a large number of idle or lightly loaded transformers on a circuit or system is often given as the reason for a low circuit or system power factor. This reason is sometimes given where the power factor is as much as 15 per cent below the value it is claimed it would be if such transformers were not present. This conclusion seems to be particularly common where the power factor of a load has been erroneously estimated to be 90 per cent or higher.

The lowering of the power factor of primary feeder circuits due to idle transformers is actually very much less, when the over-all secondary load has a power factor above 90 per cent, than it is when the secondary load has a power factor in the neighborhood of 75 per cent. If, on the other hand, the power factor of the over-all secondary load circuit is very low, for example, 60 per cent or less, the effect of idle transformers is also less than it is when the power factor of the over-all secondary load circuit is near the 75 per cent value. It is estimated that in any event the over-all effect of idle and near-idle transformers will not lower the power factor of most diversified distribution systems by more than approximately 1 per cent during medium and heavy load periods. Table II substantiates this estimate.

There is, of course, no question that idle transformers consume kva and kw and hence reduce the kva and/or kw utilization factor in a system. This is not power factor, however, where the term power factor means the factor that is indicated by a conventional power plant power factor meter, i.e., a meter that indicates the ratio of circuit kw to kva.

The examples in Table II are all based on the use of transformers which have characteristics as indicated below the table. That the table is based on only one in ten transformers being loaded is considered significant as such an effective ratio (i.e., an average of a 10 per cent load on all transformers on a distribution system) would practically never exist during the heavy load periods of the day, i.e., during those periods when it is most desirable to have a high system power factor.

Outstanding cause of low power factor in most installations is induction motors. Among these, the ¼ and ½ hp variety are notorious for their low power factor, even at full load, and, because they are so numerous they constitute a reactive load of considerable size compared with other domestic and small industrial loads. The major portion of many large industrial loads consists entirely of induction motors.

Table I is given to compare the reactive volt-amperes drawn by a group of 15-kva transformers at no load with that drawn by a 1-hp 3-phase induction motor, operating under the most favorable conditions as far as power factor is concerned, namely at full load. The power factor of split-phase motors is usually considerably lower than that shown for a 1-hp 3-phase motor.

Table I. Compares reactive kva drawn by a group of unloaded transformers and a fully loaded motor

| | Output Rating | | Input | | |
|---|---|---|---|---|---|
| Item | Hp | Kw | Kw | Kva | Kvar |
| 3-Phase 1750 rpm Induction Motor* | 1 | 0.746 | 0.932 | 1.210 | 0.775 |
| 5 Each 15 Kva. Transformers | 100 | 75 | | | 0.820 |

* Motor characteristics given above were taken from Westinghouse Bulletin 3100, Page 369, which pertains to their general-purpose line-start class 1 three-phase induction motors.

Table II. Shows effect of a number of unloaded distribution transformers on the power factor of various circuits. Results show how little the transformers lower power factor, either on high or low system loads

| Example No. | Number of Full-Loaded Transfs On Circuit | Number of Idle Transfs On Circuit | Sec Amps In Loaded Transfs* | % PF of Sec Circuit | Sum of Primary Currents** | % PF of Pri Circuit |
|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 100 | 100 | 1.006 | 99.8 |
| 2 | 1 | 9 | 100 | 100 | 1.070 | 99.0 |
| 3 | 1 | 0 | 100 | 80 | 1.011 | 78.0 |
| 4 | 1 | 9 | 100 | 80 | 1.112 | 75.8 |
| 5 | 1 | 0 | 100 | 60 | 1.012 | 58.8 |
| 6 | 1 | 9 | 100 | 60 | 1.120 | 58.0 |

* Secondary current is given in % of rated full-load secondary current.
** Primary current is given in % of rated full-load secondary current on the basis of a 1:1 voltage transformation ratio.

Note 1: The above table is based on the performance characteristics of a typical 15 kva 60 cycle distribution transformer in the 2400/4160–120/240 volt class. The characteristics used are as follows: % core loss (watts) 0.6, % resistance 2, % reactance 5, % impedance 5.1 and a no-load current which has a value equal to 1.2% of the rated full-load current, with a phase angle of −60 degrees. The % reactance used is twice that found in some 15 kva transformers, which of course causes the value of the % impedance used to be high also. These values were used in order that the table would cover practically any 15 kva 2400/4160 transformer in this respect. As a consequence the figures in the table are conservative for any transformer having the above characteristics and an impedance of 5% or less.

Note 2: The effect on system power factor caused by the presence of near-idle and idle transformers diminishes with an increase in transformer capacity providing the percent loading remains the same.

# How to Lubricate Your Chain Drive

By

**A. F. BREWER**

Technical & Research Division
The Texas Company

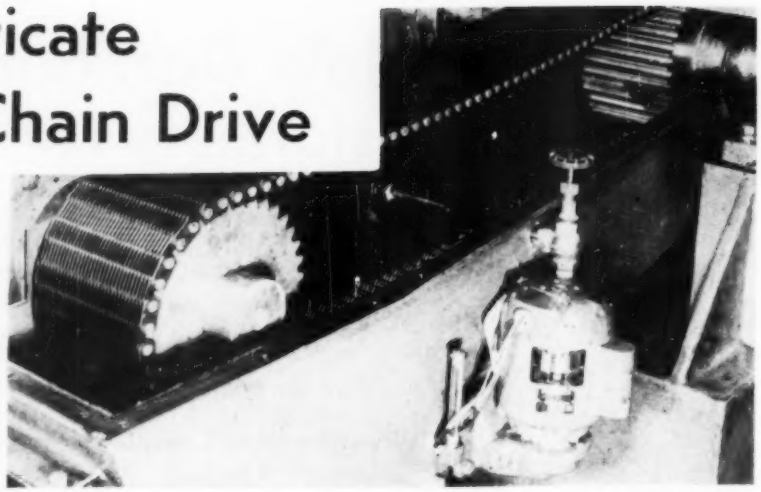


Fig. 1. A motor driven pump and spray bar for chain drive. Note pump and level gage on side of casing

**Chain drives, widely used for power transmission, must be well lubricated if they are to function properly. Here are some of the most common methods in use**

LEONARDO DA VINCI invented the first chain drive. The modern age of power transmission put it to work. Today it is used wherever power is to be transmitted from one parallel shaft to another. Like any other mechanical device the chain drive has developed from earlier, crude ideas, to become an engineering mechanism which is precision made and which offers long life when properly maintained. Wherever power consumption or link protection are factors, the builders of modern chain drives provide oil retaining casings and very often means for automatic lubrication. Chain casings also prevent accidents by reducing the hazard, not only of contact with the moving chain or sprocket, but also slipping on oil or grease drip on the floor. Chain drives also possess flexibility, a feature which helps them withstand vibration or shock.

### Types of Chains

In the course of their development three broad types of chains have resulted. They are:

1. Malleable iron or stamped steel chains
2. Roller or block type chains, and
3. Silent or inverted tooth types.

Malleable iron or stamped steel chains are generally used where speeds do not exceed 350 to 450 feet per min. They may be of the open (detachable) or closed (pintle) type according to the way in which the links engage with the pins. This type of chain requires lubrication with a comparatively heavy bodied oil, and hand application by brushing on is the most common method.

Roller or block type chains, however, are more precise in construction. As such they require, and normally receive, careful attention to lubrication. In chains of this type it is equally as important to study the design of the sprocket teeth as the design of the chain links. They are used where the distance between sprocket centers may be upward of several feet. They also are well suited to high speed service, i.e. 3500 to 5000 feet per minutes. Properly designed roller chain drives can withstand severe shock loading as well as impulsive loading, because they are less rigid than gears. At the same time they possess an inherent although limited degree of elasticity. These features also make roller chains especially suitable for very low speed service.

A silent or inverted tooth type chain is used to good advantage for a similar range of speeds but where sprocket centers are close together. Within a speed range of 1500 to 6000 feet per min, such chains are relatively quiet. The link mechanism in such a chain often requires a lower viscosity lubricant than would be used on a roller chain.

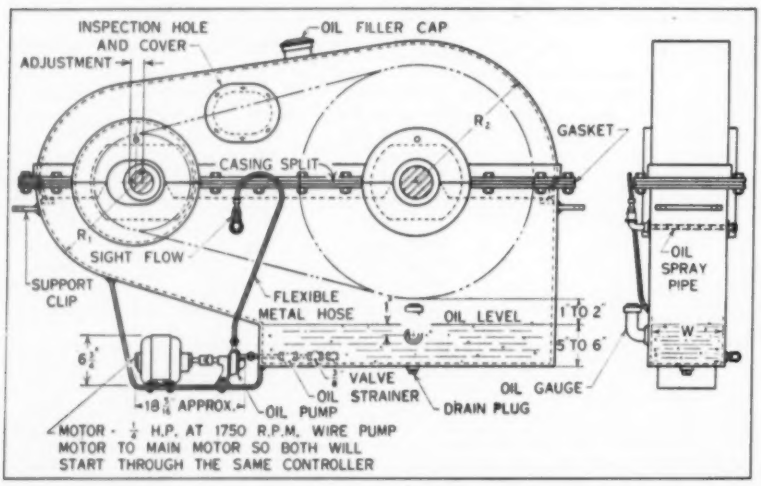



Fig. 2. Diagram illustrating force feed lubrication of a chain drive equipped with an integral oil sump

### Chain Construction

**Detachable Chains:** The detachable chain is built up of stamped steel or cast malleable iron links which engage with each other. It is probably the least expensive and simplest type in use today.

Cast detachable chains are used in materials handling for elevator and conveyor service or for sprocket drives where a low-cost durable chain is necessary and speeds do not exceed 350 feet per min. High clearances make these chains apt to wear rapidly in the presence of dirt, dust and other abrasive materials. Abrasive wear increases the pitch and frequently causes the chain links to fit unevenly over the sprocket teeth. To counteract this, a highly adhesive, semi-fluid straight mineral chain lubricant has been found to be beneficial where lubrication is possible. Often, however, it is better to run such a chain dry.

**Pintle Chains:** The pintle chain extends the application of the cast malleable iron link to a pin connected device; it is a valuable substitute for the detachable chain when operating in the presence of abrasive materials. The connecting pins are either riveted over on the ends or held rigidly in the links by nuts or cotter pins.

This construction makes pintle

chains stronger than detachable chains, consequently pintle chains can be used on somewhat heavier service at speeds up to 450 feet per min. Variations of this type of chain include the saw mill and interlocking pintle chain. This latter is built with self-contained link connections which are effective in preventing the entry of dirt, dust or other abrasive matter. On the other hand, there is sufficient end clearance to permit ready entry of a comparatively heavy gear lubricant. Once such a lubricant has penetrated to the interior wearing surfaces, this clearance serves to retain it and prevent dripping or throwing during operation.

**Roller Chains:** Accuracy and dependability are features of the roller chain. These advantages are obtained by grinding the round case hardened parts to a tolerance of a few ten thousandths of an inch and heat-treating the link plates. Machining to precision fit is an aid to subsequent lubrication and prevents abnormal wear at comparatively high speeds. Sprocket teeth are also made the same way to ensure smooth operation.

**Silent Chain Drives:** Silent chains include all such driving mechanisms built up of parallel series of links fastened to each other and to the adjoining links by pins and bushings, or seat and rocker pins. This construction gives exceptional articulating or bending ability to the entire chain, with very little wear and noise, provided lubrication is properly maintained.

The link or joint connecting device is the distinguishing feature in a silent chain. The design determines the amount and type of lubricant which should be used. Where the working surfaces of the pins are closed, lubricant must penetrate from the ends of the pins under the riveted heads. In some cases a pumping system is required to ensure complete circulation of oil. On the other hand, where the chain joint is open for the full width of the chain, the pins are exposed to complete lubrication by drip feed or oil mist method.

Silent chains are retained in proper position on the sprockets and prevented from working off by a center guide, or flanges on each side of the driving sprockets. Normally with properly aligned drives little guiding is necessary, hence the wear on the side of the guides is slight, especially as guiding takes place on the slack of the chain.

In rocker joint chains rolling friction occurs instead of sliding friction. This is attained by eliminating bushings and using two pins, one known as the "seat pin" which is built with a plane or convex surface, the other, termed the "rocker pin" which has a convex surface. By inserting these pins into the links a rocking or rolling effect is attained when bending takes place. In general, the rocker joint type of silent

(*Continued on page 126*)

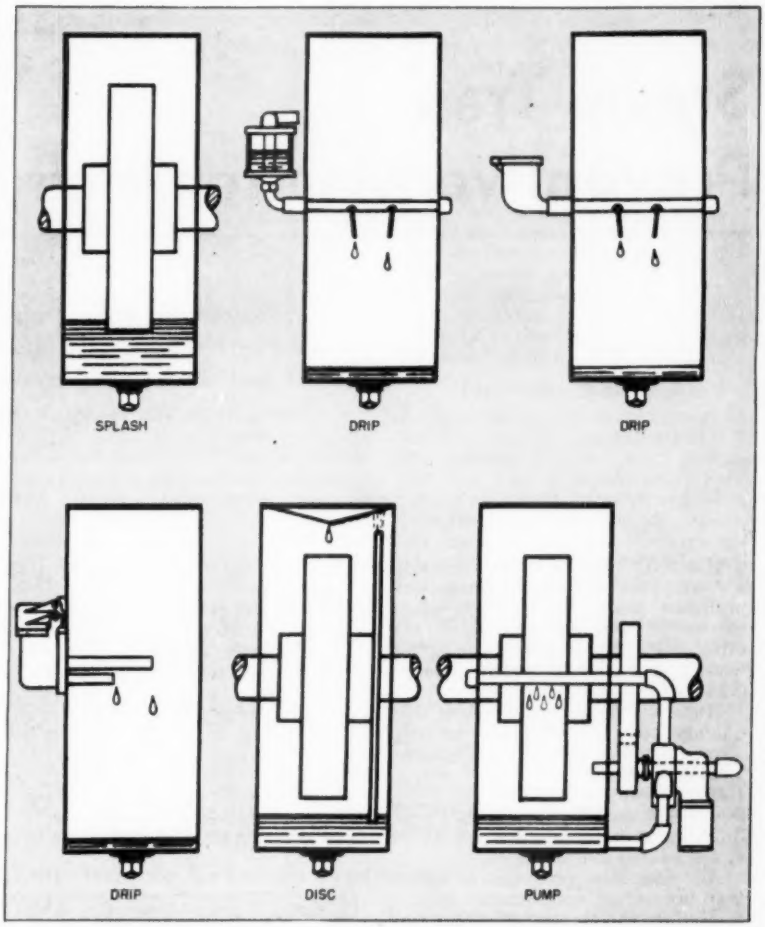



Fig. 3. Typical methods of lubricating chain drives. Splash:—chain dips into oil in sump. Drip:—several ways of making oil drip regularly on to chain. Disk:—disk fixed to shaft carries oil from sump to trough from where it drips on chain. Pump:—oil is pumped continuously from sump to drip bar

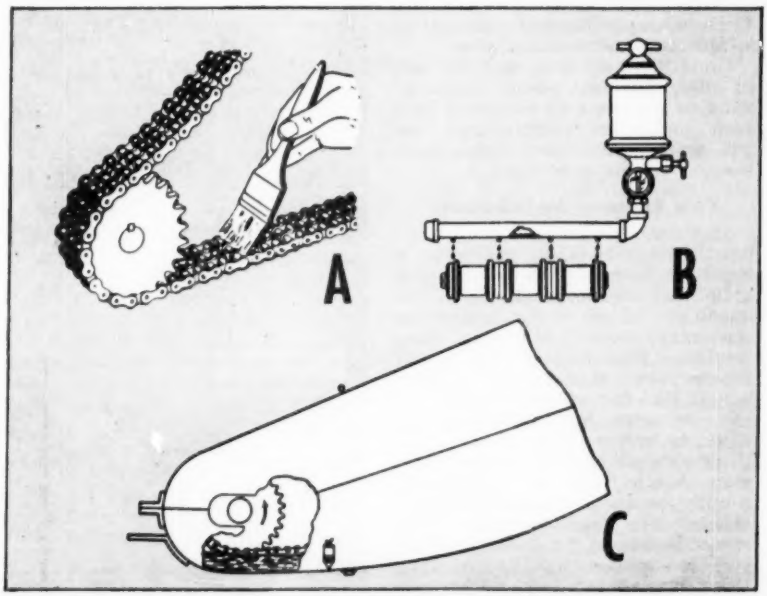



Fig. 4. Diagrams illustrating some chain drive lubrication methods. A. Manual lubrication for unenclosed drives. B. Assembly of drip bar and drip feed lubricator. C. Oil bath lubrication for enclosed drive

# Steam Trap Preventive Maintenance

**Malfunctioning steam traps can foul up an entire production line or freeze out an office staff. They can also cost plenty of fuel dollars. This concise article on preventive maintenance helps you set up a realistic counter-attack that pays off**

**By T. H. REA,** Armstrong Machine Works

DURING THE WAR and immediate post-war years, production problems had priority over plant efficiency. Now the shoe is on the other foot. Top brass is passing the word to cut costs — steam costs included.

High on the list of projects that quickly pay big dividends is good steam trap preventive maintenance. This involves:

1. Good traps.
2. Low-expense installations.
3. Periodic inspection.
4. Scheduled maintenance.

An adequate program of steam trap preventive maintenance will:

1. Reduce the amount of steam used for heat and process.
2. Reduce lost time on steam-heated production equipment.
3. Increase output per hour from steam-heated units.
4. Decrease purchases of repair parts.
5. Decrease maintenance labor.

Good traps are a must if you are to enjoy low cost steam trapping. Since we are primarily concerned here with preventive maintenance, we will assume that good traps have been, or will be, purchased.

### Low Expense Installations

In a room heated by 10 unit heaters, the trapping of any one heater is hardly as important as the trapping of a heat exchanger on which the operation of an entire processing unit may depend. No great harm would be done if one of the 10 unit heaters were shut off for maintenance. But to shut off the heat exchanger, even for a few minutes, might be very costly.

As shown in Fig. 1, a unit heater trap should have, as a minimum, a union on the discharge side and a check valve downstream from the union. However, this does not constitute low-*expense* installation. Over the years, such a low-*cost* hook-up will be more expensive than Fig. 2 which provides additionally:

1. A test valve for checking trap operation.
2. A dirt stopper:
   a. A dirt pocket to keep large pieces of scale, core sand and welding icicles away from trap, or
   b. A pipe strainer ahead of the trap. This is particularly important for small traps.
3. Unions on both sides of trap for a quick change. (See heading "Standard Connections.")

Where continuity of service is a must, low expense installations run into more money (see Fig. 3) and provide:

1. An over-sized drip leg, particularly beneficial if load varies rapidly.
2. A by-pass, so trap can be replaced or shut off without interfering with the operation of the unit.
3. A shut-off valve, as well as check valve downstream from the trap.
4. Unions on both sides of the trap.
5. A shut-off valve ahead of the trap.
6. A test valve.

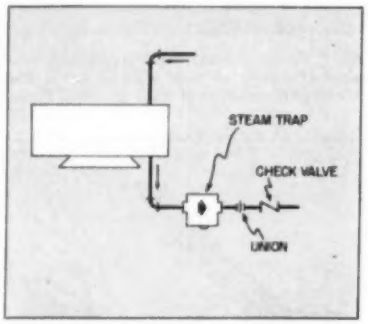



Fig. 1. Low cost unit heater trap installation has a union and check valve downstream from trap

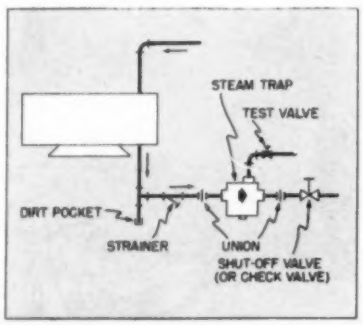



Fig. 2. Low expense unit heater trap installation adds a union, test valve, strainer and dirt pocket to expedite maintenance and shorten down time

Completeness and expense of a trap installation will depend upon the job. In some plants, all traps are installed for maximum requirements. In other plants, traps for draining low pressure heating units, for example, are installed more simply than traps on critical production units.

In general, all trap installations should provide:

1. Accessibility for inspection and maintenance.
2. A test connection.
3. Unions for quick replacement.
4. Check valves as needed.
5. Strainers at least ahead of small traps and possibly ahead of all traps.

### Standard Connections

Plants in which many traps are installed find that it pays to provide standard connections for each size and type of trap. Standard length nipples are screwed into both the inlet and outlet connections. Half unions are then screwed on the end of the nipples. Traps in stock are provided with the nipples and half unions. This simplifies trap maintenance.

Whenever a trap requires repair, a trap of the same size and rated pressure is taken from the storeroom. Unions are broken on the trap that requires attention, the trap is slipped from the line, the spare trap is installed in its place, and the unions are tightened up. The faulty trap

can then be taken to the trap repair bench and put in first-class condition before going back to the stock room.

### Periodic Inspection

Mechanical difficulties, dirt, or old age can prevent a trap from working. The trap might remain closed, causing condensate to accumulate, with loss of heat or damage to steam lines. Or the trap could stay open and waste anywhere from three cents to $15 worth of steam per day. Open or closed continuously, a trap is an expensive and troublesome liability. Obviously, then, periodic trap inspection is good business.

Trap inspection does not take a lot of time if traps are readily accessible and if they have been equipped with test valves.

Even without test valves, trap operation can be checked by:

**1. Surface Pyrometers.** First, file a clean spot on both inlet and discharge lines. If the temperature of the trap is at or near true steam temperature, and temperature of trap discharge is at or near temperature corresponding to steam pressure in the common return line, the trap is acceptable. Intermittent discharges can be detected by rise and fall of needle on pyrometer when thermocouple is contacting discharge line. If discharge and inlet line temperatures are practically the same, the chances are that the trap is blowing through.

**2. Stethoscope or Other Listening Device.** Hold one end of a steel rod against the trap cap, and the other end against the ear. Intermittent discharges can be heard clearly. Excessive rattle indicates loss of prime. Considerable experience is required for this method of testing, since other noises are telegraphed along the pipe line.

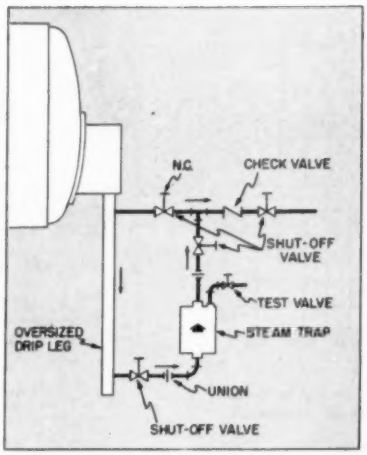



Fig. 3. Typical low expense trap installation in which continuity of service justifies added cost

**3. Glove Method Test.** Put on a pair of canvas gloves and put one hand on the inlet line and the other on the discharge line. A big difference in temperature will be quickly apparent, indicating that the trap is operating properly. Equalized temperatures suggest prime loss. If no gloves are available, tobacco juice or slippery elm juice will give comparable results if your aim is good.

Testing schedules should be determined by the pressure of the installations. The following are recommended:

**High pressure** (above 250 psig). Test daily until you have evidence that a weekly or bi-weekly test is sufficient.

**Medium pressure** (60–250 psig). Test weekly until you prove that less frequent tests are sufficient.

**Low pressure** (0–60 psig). Test monthly to yearly as your own experience dictates.

### Test Valve Indications

**A. Intermittent discharge** from an inverted bucket, upright bucket, or thermostatic trap is proof positive that the trap is satisfactory. Some flash steam will be observed along with the condensate. Do not mistake this for a steam leak through the trap valve. The amount of flash steam is in direct proportion to the amount of condensate.

**B. Dribble or semi-continuous discharge** from an inverted bucket trap usually indicates that the trap is working way below rated capacity; or this type of discharge can be caused by air mixed with the steam.

**C. Continuous steam blow.** Loss of "blue" steam at high pressure with little or no water present usually indicates that there is steam loss through the trap.

## Steam Trap Trouble Shooting Procedure

Failure of a trap to open or to close, and poor drainage due to improper trapping usually results in a call for the trap maintenance man. Trap trouble may be due to mechanical difficulties in the trap itself or to conditions in the system for which the trap is unjustly blamed. In any event, the trap man has to locate and correct the trouble.

The first thing for the service man to do is feel the trap. If it is cold, then the trouble is on one side of the fence. If it is hot, the trouble must be on the other side.

**A cold trap** may be due to line stoppages, pressure differentials or mechanical trouble. To check:

1. Open the test valve. If no water comes out, obviously we eliminate the possibility of stoppage in discharge line.
2. Crack Union ahead of trap.
   a. If condensate comes out at full pressure, the trap cannot discharge due to:
      I. Pressure differential too high.
         Wrong pressure trap installed.
         Pressure raised on system.
         Pressure Reducing Valve out of order.
         Boiler gage reads too low.
      II. Mechanical trouble, such as:
         Enlarged discharge orifice.
         Collapsed float.
         Dirt.
         Defective bellows.
         Broken parts.
   b. If condensate merely trickles from cracked union, look for:
      I. Plugged strainer.
      II. Broken valve.
      III. Plugged elbow.

**Note:** If a cold trap is replaced by a new trap from store room and the new trap remains cold, obviously mechanical trouble is eliminated as a cause of the trap not working. Look for line stoppage or excessive pressure differential.

**A hot trap** may not be working as it should. It may fail to drain condensate properly, or it could be blowing live steam. Check the following:

1. Steam loss can be caused by:
   a. Scale or pipe cutting between valve and seat.
   b. Leaky valve parts.
   c. Broken or defective operating mechanism.
   d. Dirt may prevent operation.
   e. Prime loss caused by sudden pressure drops.
      Note: Prevent by installing check valve ahead of trap.
2. Failure to drain properly.
   a. No water coming to traps.
      I. Trap installed above a leaky by-pass valve.
      II. Broken or leaky syphon pipe in syphon-drained cylinder.
   b. Continuous discharge due to:
      I. Trap too small.
      II. High pressure trap installed on low pressure job.
      III. Boiler may prime and flood system.
   c. Short circuiting. When traps are in good mechanical condition and are the right type for the job, the most common cause of poor drainage, as shown by poor production from unit drained, is short-circuiting. One large trap will discharge all condensate from an 8-roll flat work ironer; but in 99 cases out of 100, far greater production can be obtained from the ironer if each chest is drained by a separate trap.
   d. Sluggish heating not due to short-circuiting is usually caused by inadequate air-handling capacity. Basically, this is a problem of trap selection. Consult the manufacturer.

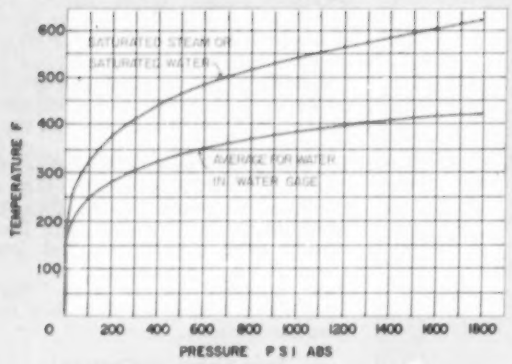



Fig. 1. Relative temperatures of water in boiler drum and in water gage at various operating pressures, found in average installations

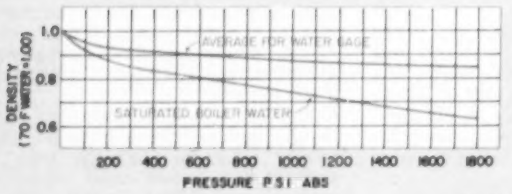



Fig. 2. Relative densities of water in boiler drum and in water gage at various operating pressures, resulting from variations of Fig. 1

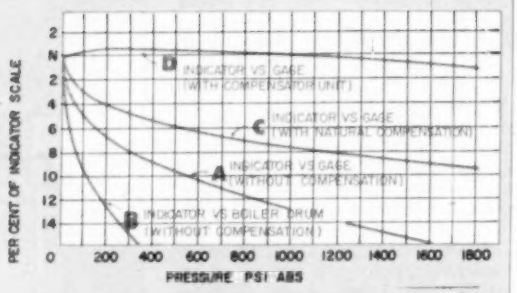

PER CENT OF INDICATOR SCALE
D INDICATOR VS GAGE (WITH COMPENSATOR UNIT)
C INDICATOR VS GAGE (WITH NATURAL COMPENSATION)
A INDICATOR VS GAGE (WITHOUT COMPENSATION)
B INDICATOR VS BOILER DRUM (WITHOUT COMPENSATION)
PRESSURE PSI ABS

Fig. 3. Percentage of error in indicator readings of water gage levels at various operating pressures and corresponding temperatures

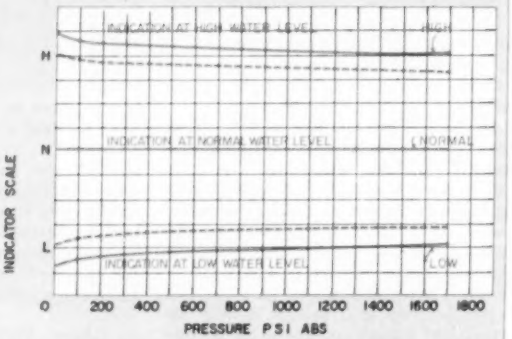



Fig. 4. Variation in range of indication for an indicator calibrated to full accuracy at 1600 psi. Dotted lines = cold water calibration

# Are You Sure Your Boiler Water Level Indication Is Correct?

**Don't guess at it! Here's how boiler pressures and temperatures affect overhead water gages and eye-level indicators, and how to compensate for their effects**

**By WALTER J. KINDERMAN**
Director of Research
Yarnall-Waring Co.

GAGE GLASSES and remote indicators readily measure changes in level of liquids of constant density. In steam boiler application, however, the density of the water varies with its temperature which, in turn, depends on the boiler pressure. As operating pressures are raised, the temperature of the water in the boiler increases and its density is reduced. These changes affect the accuracy of water level readings taken in the conventional way.

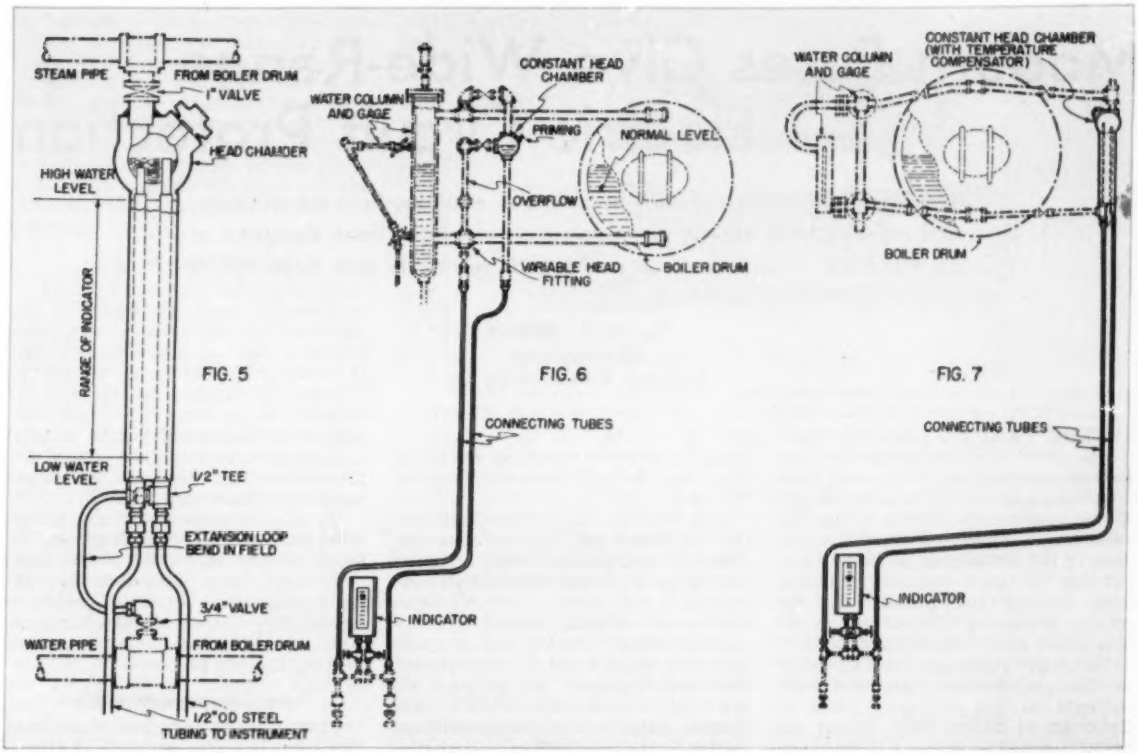
Tests show that average temperature of the water in a boiler gage glass is always lower than the steam temperature and that the water level indicated by the gage is lower than the actual level in the boiler drum. These differences may vary with the design of gage and arrangement of steam and water connections but the temperature conditions to be expected in an average installation may be approximated and are shown in Fig. 1. The higher the boiler pressure, the higher the boiler temperature and the greater the drop in temperature in the water gage.

### Effects of Temperature

Difference in temperature of boiler drum and water gage, Fig. 1, produces corresponding differences in the density of the water at these two locations. These variations are shown in Fig. 2; the higher the pressure, the lower the density and the greater the difference in densities of the water in the drum and in the gage.

**Water level gage glass reading is the accepted standard of boiler water level reference** and other water level indicating equipment should be calibrated to operate according to this standard. In many cases, the difference in water level between the gage glass, and the steam drum caused by the variations in density mentioned above, is compensated by lowering the gage with respect to the boiler drum an amount equal to the difference.

Water level indicators are normally calibrated with respect to reference water glass readings at room temperature, with particular attention to accuracy at the normal level. On low-pressure applications, such direct calibration may be suf-




Figs. 5 to 7. Water column and indicator installation details for low pressure and high pressure units. Fig. 5. Details of a typical temperature compensating unit. Fig. 6. Typical remote water level indicator connected to low-pressure boiler. Fig. 7. Typical remote water level indicator connected to high-pressure boiler

ficiently accurate; but on higher-pressure installations, allowance for density correction corresponding to operating conditions becomes desirable, and instrument calibration to such conditions is made.

### Remote Indicators

Remote water level indicators operating on the differential pressure principle are usually equipped with connecting tubes leading to the spaces in boiler drum above and below water level. One of these tubes has a fixed static head, the other a head which corresponds to changing water level. The differential pressure operates the indicating element to register all fluctuations of the water level in the boiler drum overhead. Figs. 6 and 7 show how a typical remote water level indicator is connected to the boiler fittings for both low pressure and high pressure.

### How Much Compensation?

Variations in water density in boiler drum, overhead gage glass and remote indicator installed on instrument panel or other eye-level location produce errors of indication that increase as boiler pressures are raised. Amount of this error in the reading of the average remote indicator with respect to the gage glass reading at normal level, and without compensation of any kind, is shown in Curve A, Fig. 3. Corresponding error of indication with respect to the actual level in the boiler is shown by Curve B. These curves indicate percentages of error that seriously affect the accuracy of the indicator reading, especially at high pressures. Some form of compensation, therefore, is required.

Under ordinary operating conditions, the indicator constant head fitting on the upper part of the boiler drum is filled with steam which heats the water in its connecting tube and the resulting increase in temperature of the water in this tube lowers its density and decreases the fixed head against which the varying head of the second connecting tube must operate. This change in the differential pressure at the indicator produces a higher reading which is closer to the actual water levels as shown in Curve C, Fig. 3 and up to 700 psi boiler pressure the error is not over 7 per cent, which is not considered excessive. Boiler water level indicators operating at pressures under 700 psi usually require no compensation beyond the natural compensation described above.

### Temperature Compensating Unit

At higher boiler pressures, however, the compensation produced by normal heating of the constant head connection is not sufficient for required accuracy between readings of the indicator at eye level and the water gage overhead. For pressures above 700 psi, some form of special temperature compensation is needed; Fig. 5 shows a typical temperature compensating unit for these conditions. Steam and hot condensate overflowing into right-hand variable head tube heat the left-hand constant-heat tube by radiation, thereby duplicating actual normal level gage glass conditions at these higher pressures. The resultant proportional adjustment of the temperature and the density of the water in both tubes insures true remote indication of the water level in the overhead gage within the narrow limits shown by Curve D, Fig. 3.

### How Good Are Readings?

Correction of water level readings at the remote indicator, covered by the preceding paragraphs, is made to be effective for gage glass readings at normal water level. In a typical remote water level indicator, the range of pointer travel with respect to the travel of the water level in the overhead gage is reduced somewhat at high boiler pressures. As shown on dotted line curves in Fig. 4, the indication at high water level is lowered and at low water level is raised. These variations, however, are well within accepted limits for good operation, especially in view of variations found in individual water glass readings, errors in water gage conditions following blow-down or other change from normal boiler operation. Remote indicator readings, therefore, may be considered a reliable check on the actual water level in

(*Continued on page 113*)

# Modern Fuses Give Wide-Range Electric Circuit Protection

**System short circuit capacities have grown enormously in recent years, and modern high interrupting capacity fuses have been designed to protect these circuits both on prolonged overloads and dead shorts**

**By J. C. LEBENS**
Chief Engineer
Bussmann Manufacturing Co.

IN THE PAST few years the whole science of electrical protection has been progressing rapidly to keep pace with the enormous increase in the use of electrical energy. Not only has this led to larger capacity distribution systems in industrial plants themselves, but also to larger capacity primary lines feeding the plants, thereby greatly increasing the current available under short-circuit conditions.

Not many years ago, we laughed at the thought of obtaining short-circuit currents on low voltage systems of the order of 25,000 amp. Today we have customers running acceptance tests at 35,000 amp and test stations capable of producing 200,000 amp for 250 and 600-v fuses. Hence the interrupting capacity of protecting devices is no longer an academic question to be discussed in technical meetings. It is a factor facing the electrical engineer every day.

### Code Requirements

The increased short-circuit requirements imposed by the large capacity distribution systems was obtained by building this feature into fuses of National Electrical Code dimensions in ratings up to 600 amp and by introducing a new fuse in the larger ratings. This fuse, which we call the Hi-Cap fuse, is available in ratings up to 5000 amp. It is shown in Fig. 2 and its physical dimensions in Fig. 1. These fuses are designed to be bolted directly to the bus bar instead of being installed in fuse clips similar to those used to hold fuses smaller than 600 amp.

The National Electrical Code and the Underwriters' Laboratories are silent as to large size circuit-breakers and fuses. Their attitude in this connection is that when it comes to special panel boards, circuit-breakers and equipment in heavy capacity, the jobs are engineered by competent electrical engineers and as such do not require supervision of the Underwriters' Laboratories nor special rules in the National Electrical Code.

However, the code does recognize the need for circuit-breakers or fuses of adequate interrupting capacity on heavy mains or feeders, because paragraph 1115 of the code reads: "Devices intended to break the current shall have an interrupting capacity sufficient for the voltage employed and for the current which must be interrupted."

It was for this reason that the line of large current-limiting fuses was developed, and careful study was devoted to the physical, as well as the electrical, characteristics before adopting the design. These fuses use fine silver links embedded in chemically inert arc-quenching filler. The terminals are a high copper alloy, silver plated, and sealed to the tube with "O" rings and held in the tube with screws. A glass cloth laminated base, melamine impregnated tube is used because of its excellent arc-quenching properties, high temperature resistance, and dimensional stability.

By selecting the electrical characteristics properly, the fuse can be made to open only under severe fault conditions. Since there were no existing standards to serve as a guide in establishing the electrical characteristics, many factors were considered in studying the problem.

### Fuse Temperature Rise

First was the carrying capacity of the fuse. The Underwriters' Laboratories standard which establishes the characteristics of fuses, 600 amp and less, requires the fuse to carry 110 per cent of its rated current when tested in the open. This assures that the fuse will carry 100 per cent of its rating when installed in fuse cabinets and switches in the field. The Underwriters' standard further specifies that the temperature of the terminals of the 600 amp fuse shall not rise more than 75 C when carrying 100 per cent load.

For this reason it was decided that our fuse should be designed to carry 110 per cent of its rated load when tested in the open, and it should open at 150 per cent of its rating within one hour. Also, the temperature rise of the terminals shall be limited to 75 C when the fuse carries 110 per cent load.

Actual tests show that if the fuse

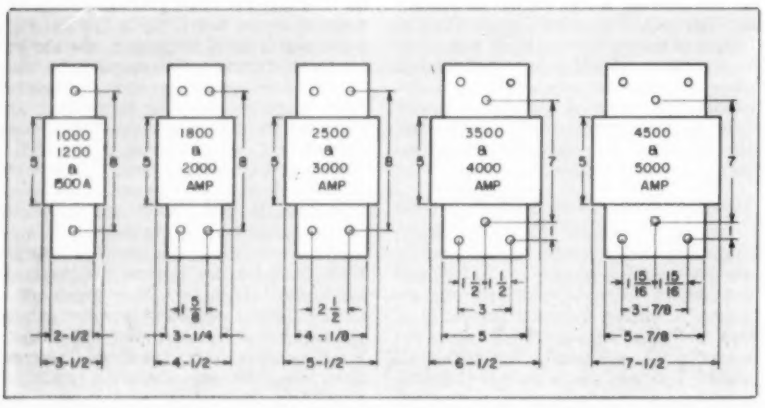



Fig. 1. Dimensions in inches of some typical large current limiting fuses of the type shown in Fig. 2

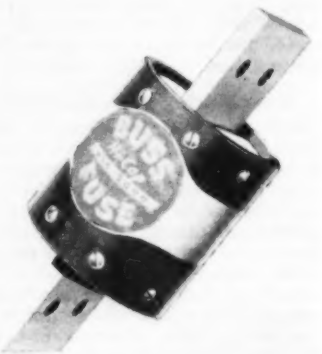



Fig. 2. Shows typical Hi-Cap current limiting fuse

is replaced with a copper bus bar, bolted in place, the bolted connections show a maximum rise of 45 C when carrying 110 per cent load. Hence, the fuse is actually causing a rise of 30 C maximum when carrying 110 per cent load. This cool operation requires special design of the silver links and careful selection of the terminal bolts to eliminate all unnecessary heating.

### Fuse Coordination

Having once established the manner of rating the fuse, it was then necessary to establish the time-current characteristic so that it would coordinate properly with fuses of smaller rating commercially available. Before the time-current characteristic could be selected, it was necessary to decide what type of fuse should be used in the coordination study. The Fusetron dual-element fuse was the logical choice.

If all the improvements which have been built into low voltage fuses throughout the years are sacrificed in obtaining interrupting capacity, little is gained and history is merely repeating itself. Originally the sole function of the low-voltage fuse was the protection of circuits against heavy short-circuit currents. Such fuses had low thermal capacity so that once the current exceeded their rating, they blew rapidly. Because of this lack of time-lag it was necessary to select the fuse size large enough so that it did not blow under ordinary harmless transient conditions, produced by the starting of motors, switching of capacitors, or the like. Hence, the fuse was capable of giving only short-circuit protection, and overload protection required an additional device.

No satisfactory answer to the problem of complete protection was found until the dual-element fuse was developed. This device has sufficient thermal capacity to carry the low overloads as long as the wiring and associated equipment is not injured but will open to clear the circuit if these overloads are continued beyond a safe time.

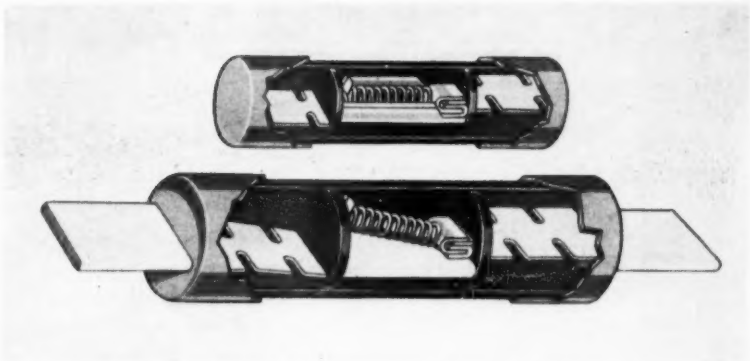


Fig. 3. Fusetron dual-element fuses. Small overloads operate thermal overload device in center; heavy overloads melt strips at each end of fuse causing device to operate as an ordinary fast acting fuse

Under normal satisfactory conditions, the current can vary within extremely wide limits without injuring the equipment as long as the current is not permitted to flow longer than a predetermined safe time. Under faulty or dangerous operating conditions these same currents are maintained long enough to damage, if not destroy, the device. The demarcation between satisfactory and faulty operation is a matter of time at any particular value of current. If the current is cut off before damaging conditions are reached, the electrical machine is not being operated at its full capacity; whereas if the current is allowed to continue too long, the machine is destroyed. Hence, for complete protection, the time-current characteristic of the protective device must match the safe time-current characteristic of the electrical equipment. Otherwise little more than short-circuit protection can be guaranteed.

Since heat generated is proportional to the square of the current, the safe time of the equipment steadily decreases as the current is increased, the shape of the safe time-current characteristic being approximately a square law curve.

### Safe Time

The curve actually varies from a true square law curve by a factor unique for each machine, depending on its thermal conduction, radiation, and thermal capacity.

As the current is increased, a point is finally reached where the heat generated in the electrical path is so great that the wire itself melts before any heat can be conducted from it. At these very high overloads or short-circuits extremely short safe times result. Hence the shape of the safe time-current characteristic curve at

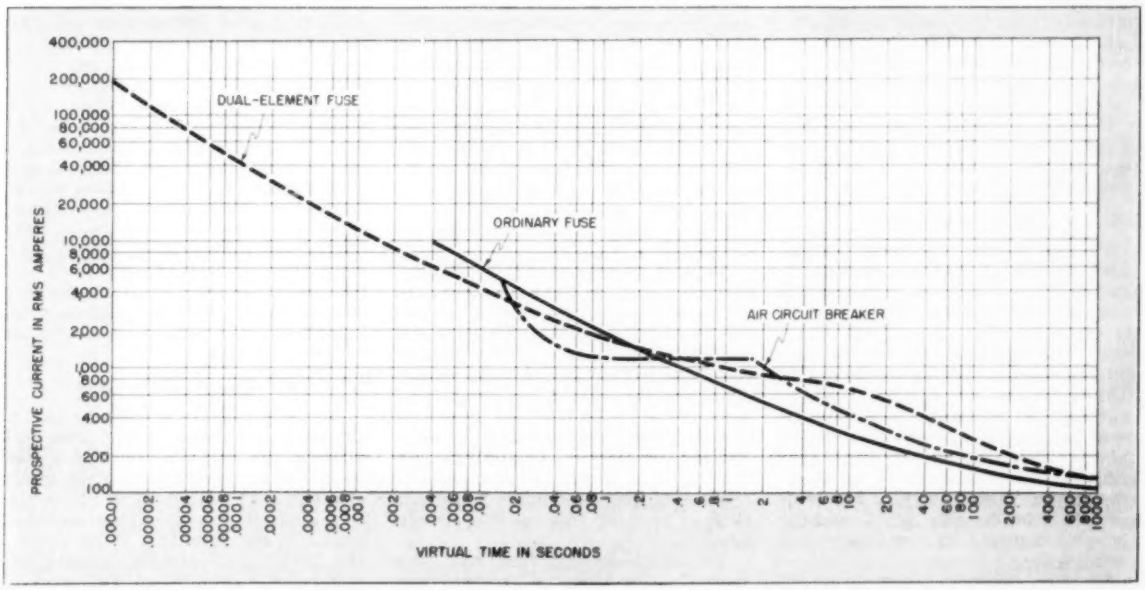



Fig. 4. Time-current characteristics compared for a one-time fuse, a dual-element fuse, and an air circuit breaker. Each device has a 100 amp normal rating

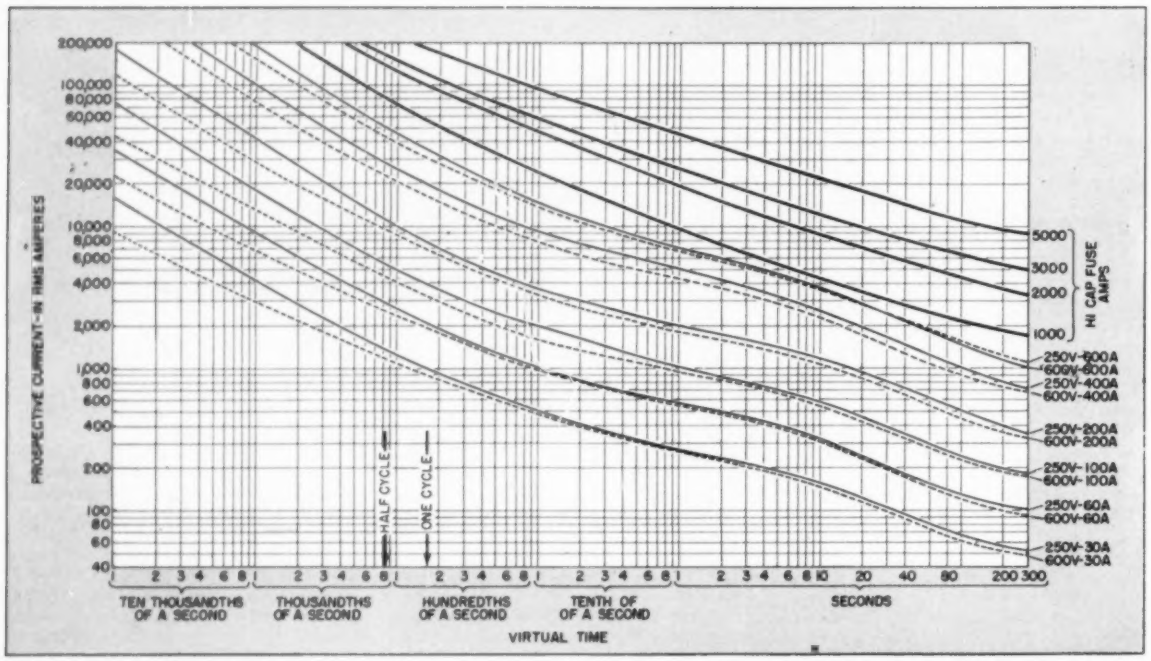



Fig. 5. Time-current characteristics of dual-element and Hi-Cap fuses. Prospective current is current that would have flowed if a fuse had not opened the circuit

these overloads is a square law curve having an extremely steep slope.

To match the equipment the ideal protector should have ample time-lag at the lower overloads to obtain maximum capacity but virtually no time-lag under short-circuit conditions so that they will clear heavy fault currents so rapidly that they will be incapable of causing injury. The dual-element fuse shown in Fig. 3 has such a time-current characteristic.

The dimensions of the dual-element fuse conform to the standard for fuses as shown in the National Electrical Code and the dual-element device is listed by the Underwriters' Laboratories as a fuse. As shown in the figure it consists of a short-circuiting strip surrounded by arc-quenching filler in each end of the fuse with a thermal overload device in the center. Current flowing through the fuse generates heat in the short-circuiting strips.

### How It Works

At the lower overloads, where there is time for thermal conduction, the heat is conducted into the thermal overload device in the center raising its temperature to 280 F at which point the fusible alloy melts permitting the interrupter to move mechanically, under spring tension, opening the circuit. At the higher overloads, where there is no time for thermal conduction, the heat generated in the weak spots of the short-circuiting strips raise their temperature to the melting point causing them to operate like ordinary fast acting fuses.

By combining a thermal cutout with a fast acting fuse link in the same fuse case, sufficient time-lag can be built into the device to eliminate needless blowing on harmless overloads and still obtain fast action under short-circuit conditions. In Fig. 4 the time-current characteristics of the dual-element fuse, an ordinary one-time fuse, and an air circuit-breaker are plotted together.

All three devices are rated at 100 amp. All three are capable of carrying 100 amp indefinitely and will open at 135 amp in approximately the same time. However, from this common starting point the characteristics of the three devices diverge as shown. The ordinary one-time fuse, having relatively little thermal capacity and only one mode of operation, has a smooth time-current characteristic without any points of inflection. It has little time-lag at the lower overloads so that it will open on harmless transients. Even so it is slower than the dual-element fuse under short-circuit conditions. The curve is cut off at 10,000 amp because tests have not been conducted at higher fault currents.

The air circuit-breaker is thermal-magnetic and has more time-lag than the ordinary one-time fuse at the useful overloads. Up to 1000 per cent load the bimetal trip of the breaker functions so that the thermal capacity of the unit affects its time-current characteristic. At 1000 per cent load the magnetic trip comes into play, causing the curve to drop off rapidly to a time of about one cycle which represents the irreducible minimum time of opening this type of circuit-breaker.

The dual-element fuse has even more time-lag than the ordinary one-time fuse or the circuit-breaker at the useful loads, but at fault currents its time of opening drops to an amazingly short value. Until recently the only short-circuit tests conducted by unbiased laboratories on low voltage fuses were those of the Underwriters' Laboratories on direct current with 10,000 amp available. Even though field experience with fuses has been unusually successful, no basic information about the performance of the fuse on heavy a-c fault currents was available. To obtain this data, tests witnessed by the Electrical Testing Laboratories of New York were conducted on 250 and 600 volt dual-element fuses on circuits capable of delivering peak currents as high as 235,000 amp a-c at rated voltage.

These tests show that the dual-element fuse safely interrupts the maximum current available at rated voltage with only one fuse in series with the short-circuit. Even though other tests proved that this was the most severe condition, 3-phase short-circuits equivalent to the 3-phase circuit-breaker test were also conducted. The results of these tests were equally satisfactory. It is for this reason that the time-current characteristic on the dual-element fuse in Fig. 4 is carried up to a value of 200,000 amp.

### Prospective Current

Actually it is impossible to plot a time-current characteristic from full load to the current available under short-circuit conditions for the dual-element fuse without introducing a new concept. Since the dual-element fuse is current limiting in its action, the heavy short-circuit currents are shut off before they can flow, so that

*(Continued on page 113)*

# What Is Qualifying Experience for the Professional Engineer's License?

**Is your experience rated as professional, non-professional or sub-professional? Your license as a professional engineer may depend on it, so don't wait for the verdict of the Board of Examiners. A look through this article may save you years of fruitless effort**

**By JOHN D. CONSTANCE**

Consulting Engineer

*Editor's Note: Mr. Constance is now on the teaching staff of the New York State Society of Professional Engineers, Kings County Chapter, but is limiting his teaching activities so that he will be able to conduct guidance programs for license candidates in other parts of the country. His 10 years of experience in this work lend weight to his article, as with his two previous articles in* POWER ENGINEERING *(page 78, August, 1952, and page 86, April, 1953).*

*He is also author of: Refresher Notes for PE License Examinations; compilations of past N. Y. state examinations; instructions for filing license applications and other helps.*

WHEN AN APPLICANT files for his Professional Engineer's License, the question of what constitutes "acceptable" experience often is given only passing attention. As a result, this information is not well documented in the application. Nevertheless, in evaluating a man's experience, the members of the Board of Examiners must reach their decision by what is written in the application; they cannot read in between the lines and they cannot go by hearsay. Therefore, an application is not the place for modesty. It is not enough to list job titles, no matter how impressive. The record must give the complete story and must describe the applicant's functions in detail, leaving no doubt on the part of the board as to the nature and value of the applicant's experience.

### Model Law Requirements

Requirements for registration are rather difficult to describe in general terms. There are differences in the registration laws of the states and territorial possessions, due to the time that the law was passed and also to local conditions. But the "Model Law," which has been followed by most states, has the following three alternate standard requirements:

1. The first one is graduation in an approved engineering curriculum plus four years or more of experience in engineering work of a satisfactory character.

2. If a man is not a college graduate, eight years or more of engineering work of a satisfactory character, plus a written examination. The written examination is to show that the man has acquired his education in some way other than in college.

3. Twelve years or more of lawful practice in engineering work of a satisfactory character indicating that the applicant is competent to practice engineering, and provided the applicant is not younger than 35 years. This requirement is for the man of long-established practice. Many states now require all applicants to pass a written examination, except those of recognized standing and long experience.

Engineering experience ust be of a grade and character sati actory to the applicant's Board of xaminers, and the acceptable amo nt is often less than the elapsed time after graduation. The number of calendar years of experience does not necessarily equate the same number of years of satisfactory "approved" experience.

### Theory Plus Experience

Acceptable engineering experience is something that defies exact definition. However, it is predicated on a knowledge of engineering mathematics, physical and applied sciences, properties of materials and the fundamental principles of engineering design. Most Boards insist that this experience be broad in scope and of such nature as to develop and mature the applicant's knowledge and judgment.

The experience record must show how much and what kind of engineering experience the applicant has. It must show progression to more important work and greater responsibility on the job. It must call for more than the routine observation and recording of technical data and for more than systematized and unvarying operations. The applicant must show more than a passing interest and initiative in his work and one as to reflect that he has developed professionally. Experience should be diverse but complete and not narrow and limited in scope.

Knowledge of the basic fundamentals of science and mathematics alone does not satisfy the requirements. Evidence of the ability to use these fundamentals in the design of engineering works rather than simply operation experience is adjudged "acceptable" experience. Design in its broadest sense and not solely confined to making drawings and computations is the intent.

Problems in mechanical engineering, for example, cannot be handled adequately or on a professional level except by one with a good working knowledge of hydraulics, thermodynamics and mechanics of materials and other related subjects. One cannot be considered to have developed to the professional level in his field until he understands the effect of varying loads on equipment.

Professional experience in Mechanical Engineering may include: design and/or supervision of construction of machines; machinery and mill layouts; heating, ventilating and air conditioning; power plants; power plant equipment; industrial layouts; refrigeration; tools and processes; internal combustion engines; development of industrial plants and processes; consultation; appraisals and investigations; research and economic studies; cost analyses.

The applicant who has spent many years in the field of mechanical engineering may not qualify as a professional engineer under this situation. Draftsman experience to qualify at the professional level must include a considerable amount of varied and complex design experience. Experience as an apprentice draftsman or as a detail draftsman should not qualify. Detailing and other routine design work is not qualifying in accordance with the strictest interpretation.

### Titles No Criteria

Salaries and titles are not necessarily good criteria for determining professional experience. Some draftsmen doing high grade routine work, but still sub-professional work, make good salaries. The same may be said for men doing routine engineering work in desk jobs. Some draftsmen and "engineers" become highly proficient in the use of handbooks and other devices for speeding up design

*(Continued on page 114)*

# How Much Oil in Your Feedwater?

**You can remove oil from feedwater in several ways*; but first, how do you find out how much oil it contains? Various practical ways of doing this are reviewed in this article**

**By GEORGE S. EMMERSON**

Assistant Professor, Engineering Department, San Jose State College

IT IS VERY MUCH easier to detect oil in water than to estimate its concentration, and both tasks are very difficult where the oil is emulsified or there is not much of it. A method commonly applied by engineers to detect the presence of oil in boiler feedwater is to allow a water sample to settle in a Nessler tube or clean glass for a number of hours, after which the free oil — as distinct from the emulsified oil — should form a film on the surface. By holding the tube against a light, this film can be easily observed and, if there is also a substantial concentration of emulsified oil, the water will appear cloudy.

Another method is to suspend a thin strip of camphor in the water; if the strip moves sluggishly, oil is present, but if it darts about rapidly, the water is oil-free. These methods have some use where the boiler has a comparatively high tolerance for oil, but if it has not — and this is true for most water-tube boilers — they are of little value.

### How Little Oil?

A concentration of oil, too minute for detecting this way, may yet be enough to cause serious damage. Where oil may enter power plant condensate from, say, failure of steam heating coils in oil heaters or other external sources, enough oil may be present to work a photoelectric alarm system operating on the principle of the turbidimeter or tyndalmeter (if the oil is finely emulsified), or a conductivity meter. The turbidimeter and tyndalmeter will be discussed presently.

Concentration of oil a boiler will tolerate depends on too many operational and design factors to be declared with certainty. For instance, suspended impurities in the boiler water will sometimes coagulate the oil and settle in a sludge, or they may cause an oily scale to form on the heating surfaces and produce foaming and priming. One thing is certain — oil in any concentration is a potential danger in boiler water.

American Boiler Manufacturers Association standard contract states: "The total quantity of oil, or grease, or substances which are extractable either by sulphuric ether or by chloroform, shall not exceed 7 ppm in the boiler water when the sample being tested is acidified to 1 per cent hydrochloric acid, or 7 ppm in the feedwater when the sample being tested is first concentrated at low temperature and pressure to the same ppm total solids as the boiler water" (see American Boiler and Affiliated Industries Manual of Industrial Standards and Engineering Information).

To achieve this standard of purity — which, it should be noted, is purely an arbitrary standard based on experience — it would be necessary to keep most concentrations of oil in feedwater below about 0.4 ppm. The U. S. Maritime Commission and the U. S. Navy have gone so far as to stipulate 0.1 ppm as the maximum permissible oil content of boiler feedwater on the ground that this is attainable by certain types of filter operating with coagulants or filter aids.

### Measuring Methods

Accurate measurement of minute oil concentrations of this nature is extremely difficult and essentially a laboratory procedure, although certain optical methods to be discussed presently may lend themselves, within limits, to ready application in the boiler room.

Analytical methods for measuring oil content of boiler feed and boiler water are simply refinements of the basic principle of extracting the oil from a sample of water by a suitable solvent, evaporating to dryness, then weighing the residue. A standard method (see American Public Health Association Publication Standard Methods of Water Analysis, 8th ed., p. 117, 1936) is to evaporate two to four liters of the water to dryness at less than 100 C (212 F). The residue is taken up with petroleum ether or high test (oil-free) gasoline in a tared platinum dish or small light beaker, and evaporated to dryness on a steam bath. The oil content is then determined by weighing.

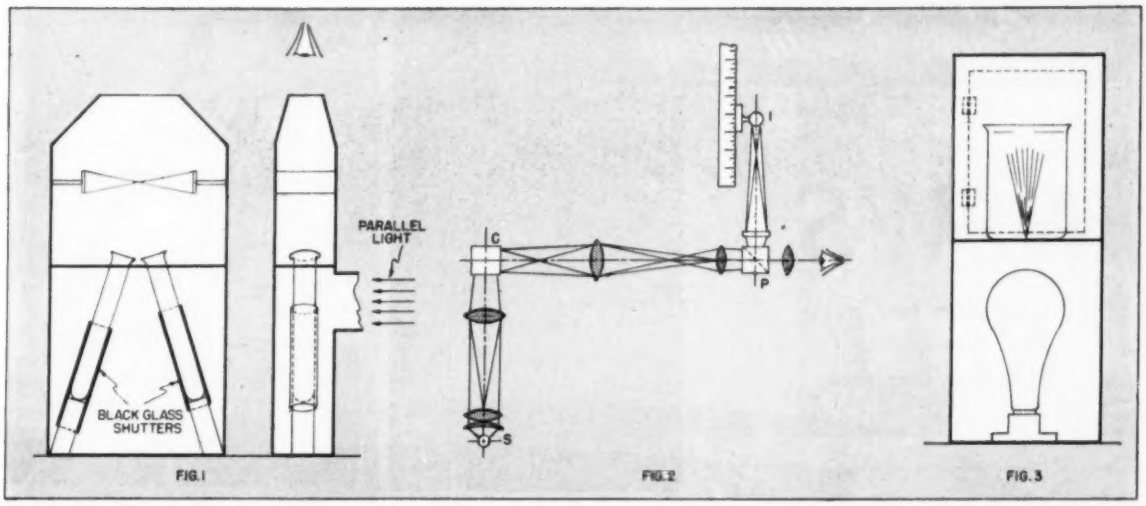
Better method is to transfer the sample of oily water to a separating funnel and shake it up with redistilled chloroform or ether. The water and chloroform layers are separated and the chloroform is evaporated in a weighing flask and dried to constant weight at 100 C. The oil content is then determined by weighing as before (see Technical Methods of Analysis, Griffin, 2nd ed., p. 702, New York, McGraw-Hill Book Co., 1927). Pringle (J. Soc. Chem. Ind. 60, 173, 1941) advocated the use of benzene in place of chloroform or ether because of its lower solubility in water (0.073 per cent at 22 C).

Unfortunately, benzene forms an emulsion with water, which will not separate within 24 hours. Pringle overcame this difficulty by generating hydrogen within the sample by first adding concentrated hydrochloric acid, then introducing a magnesium wire loosely wound on a glass rod.

### Sources of Error

A source of error in these methods is the presence in the oil residue, after evaporation, of substances other than oil which have also been taken up by the solvent. In boiler water, these are mainly sodium sulphate and sodium chloride. This leads to an erroneously high result, for the impurities are then weighted along with the oil.

* These ways were discussed in detail by the author in the following articles in POWER ENGINEERING: What to Do About Oil in Boiler Feedwater, February, 1952; Filters Will De-Oil Your Boiler Feedwater, April, 1952; Chemical De-Oiling of Your Boiler Feedwater, July, 1952; Electric De-Oiling of Your Boiler Feedwater, October, 1952.




Figs. 1 to 3. Apparatus used to measure amount of oil in feedwater. Fig. 1, Richards' Nephelometer; Fig. 2, Tyndalmeter; Fig. 3, Adaptation of Tyndalmeter

Method which avoids this error, and is described by Scott (Standard Methods of Chemical Analysis, Vol. 11, 5th ed., p. 2078, New York, D. Van Nostrand Co., 1939), is based upon the use of ferric hydroxide flox — produced in the oily-water sample by adding ferric chloride and ammonium hydroxide — to coagulate the oil. The oil is subsequently extracted from the floc and weighed.

Noll and Thomlinson (Fixing and Determining Oil in Feedwater and Boiler Water, *Ind. & Eng. Chem.* (Anal. Edn.), v. 15, p. 629, Oct. 1943) found, however, that a much more serious error arose from the separation of the oil onto the sides of the vessel containing the oily-water sample during delay prior to analysis. It was found that this film of oil could not be removed completely from the sides of the vessel by rinsing with the solvent. Noll and Thomlinson therefore proposed that the floc be added to the sample at the time it was taken, and they presented a detailed description of their method in their paper.

### Optical Methods

Estimating the concentration of suspended particles in fluids by reflecting or absorbing a beam of light has long been used in the chemical industry. The instruments devised for this purpose are of three kinds: the turbidimeter, nephelometer, and tyndalmeter.

The turbidimeter, as the name implies, measures the turbidity of a solution on the principle that the amount of light from a given source passing through the solution is proportional to the turbidity of that solution. It is evident that the precision of this method decreases as the percentage of light absorbed decreases, and for small concentrations of oil in water, accurate determination of turbidity becomes impossible. The oil-water emulsion normally found in steam engine condensate is very dilute indeed and consequently its assessment by estimating turbidity is impracticable.

On the other hand, the nephelometer is designed to estimate turbidity by measuring the amount of light reflected from it, this being proportional to the concentration of impurities. This principle is quite distinct from that of the turbidimeter, which depends upon the light absorption of the impurities.

### Nephelometer

The Richards Nephelometer, shown in Fig 1, which has been adapted for measuring condensate emulsions (see Ridsdale Ellis, *J.S.C.I.*, p. 908, 1910), consists of two identical clear glass tubes at an angle to each other. The solution to be examined is contained in one tube while the standard against which it is to be compared is in the other. Two bands of asphalt paint are located on the tubes to subdue reflections from the liquid meniscus and from the bottom of each tube. Black glass shutters slip over the tubes and can be kept in any position by brass splines, to exclude light from the tubes as desired. Scales on the pillars indicate how much of the clear portion of each tube is exposed.

The observer looks down through the aperture at the top of the box through two prisms of 15 deg apex angle, arranged to produce two semi-circular images on a common diameter. The shutters are adjusted until the two semi-circular sections appear equally bright. The exposed lengths of the tubes are then inversely proportional to the concentration of suspended particles in the specimen compared to the standard.

It is most important to make sure that the standard and specimen are exactly comparable, and this is not always easy. Opalescence varies with the size of particles, method of preparation, and color. Ridsdale Ellis used a soap solution as his standard with condensate emulsions.

The tyndalmeter is a nephelometer for very clear liquids, making it possible to measure emulsion concentrations as dilute as 2 ppm. Intensity of the reflected beam is proportional to the concentration of suspended matter, provided the concentration is not sufficient to absorb an appreciable fraction of the light. For this reason it is best used on an emulsion of fine particle size, and the presence of free oil or colloidal impurities will impair its reliability and usefulness. Various designs of tyndalmeter are available, differing only in the way they estimate the intensity of the reflected beam.

Elements of the instrument are shown in Fig. 2. A bright parallel beam of light from source "s" is concentrated on the sample of liquid in cell "c". Scattered light from cell "c" strikes the photometer cube "p" where its brightness is compared visually to that of the illuminator "I". Tolman and Vliet (*J.A.C.S.*, Vol. XLI, 297, 1919) used a Macbeth illuminator in their simple fabricated tyndalmeter, and Cummins and Badollet (*Ind. Eng. Chem.*, Anal. Ed., 5, 32B 1933) utilized a luminous surface moved back and forth on a scale. The tyndalmeter may be calibrated with the aid of suspensions of known concentration such as silica solutions or turbid glass.

### Measuring Is Difficult

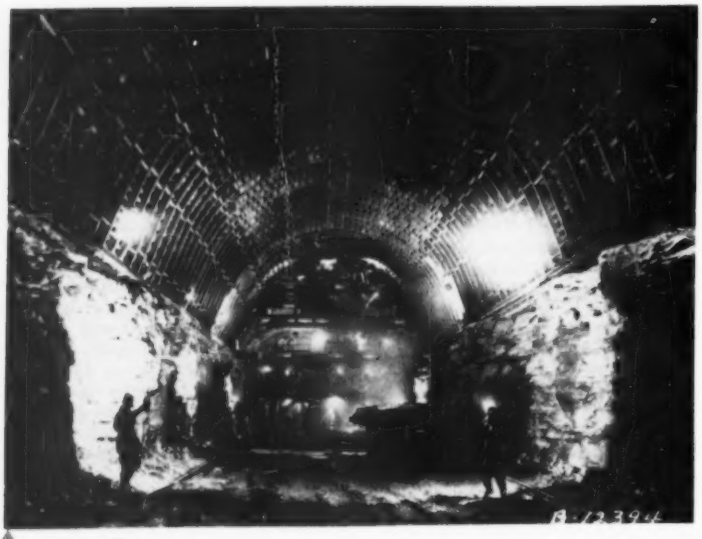
Accurate measurement of even 0.5 ppm of oil in water by any of the analytical methods discussed here is well nigh impossible, as, with minute concentrations of this order, the weight of oil extracted from the sample may be less than the weight of moisture absorbed by the weighing apparatus on exposure to the air. This demands fine instruments, close humidity and tempera-

(*Continued on page 117*)

Power Engineering

# NEWS REEL

1



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**1** A 122.5-ton fan rotor for the Moffett Field wind tunnel begins the second leg of its trip to California. It was shipped from G.E. at Schenectady on a special flatcar, transshipped on SS Garfield

**2** One of two 45-ft diameter tunnels, which will divert one-fifth of Niagara's flow to the Canadian Sir Adam Beck generating station, is shown with steel forms in place for pouring its 3-ft liner

**3** E. C. A. Citation Award-winning Palermo Steam Power Plant has been completed. Expected to speed economic recovery of Sicily and southern Italy, the plant includes three 30,000-kw generating units

**4** Fresh'nd Aire Co. of Grayslake, Ill., spots leaks of Freon 12 gas in their hermetically sealed air conditioning systems and dehumidifiers with a G.E. detector. Leaks requiring 5 years to impair operation are found by audible or visible signals

3

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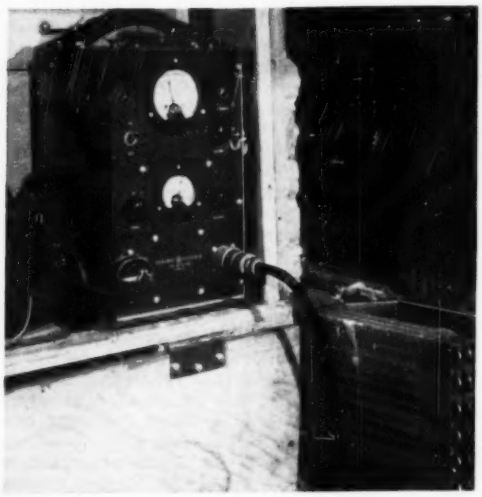

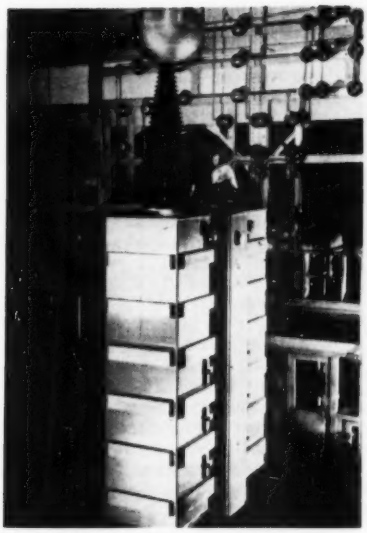

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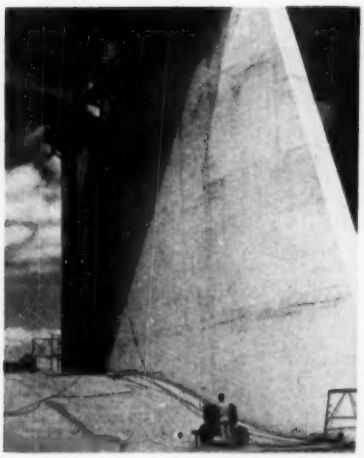

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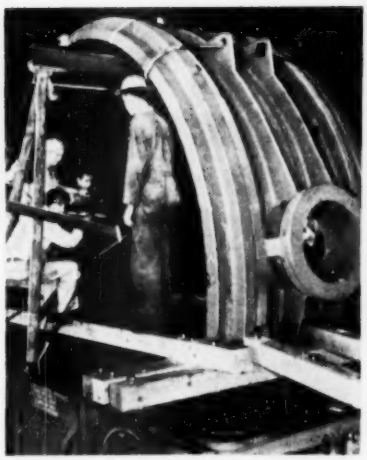


7

Latest step in A-C's five-year development program for efficient coordination of high-voltage insulation, this transformer is rated 600 kv, 5000 kva — 5

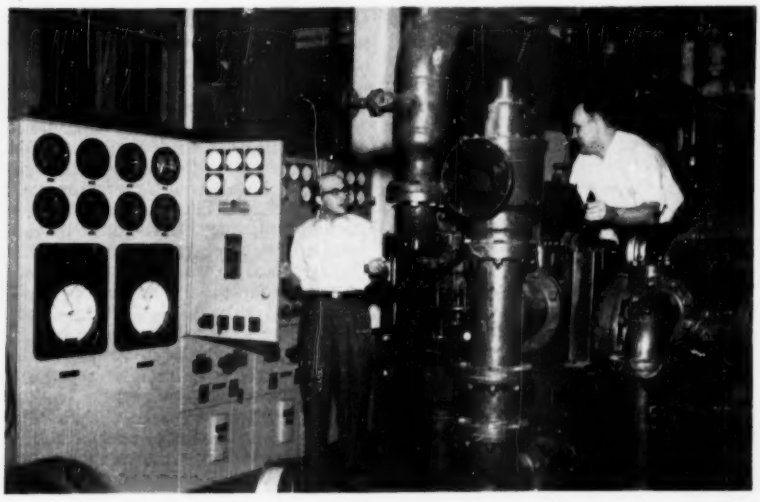
Giant spillway door in the new international Falcon Dam on the Rio Grande. The dam, just dedicated, harnesses the Rio Grande's power and water — 6

This 13-ft diameter butterfly valve, shown dismantled for shipping, is on its way to Pacific Gas & Electric. Framework of steel and wood supports it — 7

Power for this dredging, washing and screening operation comes from an Atlas diesel and a Superior 100-kw generator. Dredge is on Ohio River — 8

"Professor grease monkeys" Bacha (left) and Moore of Rutgers University M.E. lab proved themselves practical engineers by installing this steam turbine when the installation funds failed to appear — 9

8



9

# Plan Protective Painting to Reduce Electrolytic Corrosion

**Electrolytic corrosion costs country millions of dollars every year. It can be minimized by right choice of metals and protective paint**

By L. G. JONES

FOR PROTECTING metals with paints or coatings, the result is the same whether the corrosion is caused by oxidization or electrolytic action. There is, however, enough difference in cause and cure to warrant their separate study. Oxidization or direct atmospheric chemical corrosion was discussed in our July issue; this article is concerned with protection against electrolytic or galvanic types of corrosion.

Galvanic corrosion may be defined as the accelerated electrochemical corrosion that one metal surface suffers when in electrical contact with another more noble metal, both being immersed in the same corroding medium, called an electrolyte.[1]

Amount of corrosion in terms of metal loss depends upon the quantity of current generated rather than the potential difference. Metal is lost in the electrolyte as electrically-charged metal particles that leave the metal anodes at points where the coating or film is broken or discontinuous. The electrolyte can be condensed moisture in structural joints, water in water heaters, ground moisture surrounding pipe or metal cable, or any water contiguous with metal. Simultaneous emission of an equivalent number of electrons from the oxidized surface results in the formation of hydroxylions, as the current flows, with the generation of hydrogen. Amount of reaction depends upon the amount of oxygen available, the chemical composition of the electrolyte, and the removal of the hydrogen from the electrodes or metal surfaces.

### Corrosion Rate

Potential of the metal with respect to its adjacent electrolyte is a measure of its tendency to discharge ions or to corrode, but this potential does not really determine the rate of corrosion. It is actually the polarization of the electrode surfaces or hydrogen removal that controls the current flow or the rate of corrosion, rather than the potentials shown in the electromotive series. Differences of potential may occur on the surface of one metal when the structure of the metal is not uniform, because of strains or segregations of impurities, such as graphite (carbon) and ferrite (iron) in cast iron.[2]

This last source of potential difference is a common cause of corrosion, because with the very low potentials generated, metal to metal contact and a path through metal is almost a requisite for appreciable depth of corrosion. Oxide films and polarization would otherwise interpose sufficient resistance to prevent galvanic corrosion.

Galvanic corrosion can first be reduced by the proper selection of metals in any structure. It would be poor practice to place two metals in electrolytic contact which are far apart in the electromotive series. This is one of the big problems in power transmission where aluminum conductors are joined with copper wire, leads, busses, and the like. Tinned copper connectors would halve the potential, but for long life dissimilarity of metals will have to be eliminated.

### Deep Corrosion

Deep corrosion can be avoided by using a large area of the anode or electropositive metal in contact with small areas of the noble metal. This phenomenon of metal area ratios is one of the causes of pitting or point failures in boilers, piping and tanks.

A break in a protective film, such as paint, cladding, passivating film, or other protective coating, exposes a pinpoint area of the sacrificial or corroding anode to a far greater area of the cathode. This concentrates the current amperage that could be developed by the large area of the cathodic metal to the small area of the protected metal so that rapid corrosion could take place in this small area. Rivets and bolts joining corrodible metals should be of monel or stainless steel, which are corrosion resistant smaller area metals.

Coating all metals in the electrolytic area, both anodes and cathodes, with impermeable paints is important. The paint or coating must remain continuous without breaks or checks in order to be protective and to stop galvanic current penetration as long as the film holds. Before painting these surfaces any scale or adherent rust or materials should be thoroughly removed by chemical (pickling) or mechanical (sand-blasting) methods. Such scale, should the mass become wet, buried or submerged, may become cathodic to the metal under it and galvanic pitting and loss of metal will result. Steel surfaces are especially subject to this type of corrosion.

For long life, underground piping and other metal structures are generally coated with hot coal tar enamels. A very heavy hard continuous coating results, which resists abrasion and checking. It is exceedingly important that no breaks be left in the coating before burial under the soil. Continuous electrolytic action from the ground moisture, low in intensity, concentrating in these breaks produces pits in a comparatively short time, while the balance of the metal surface is as good as new. An example of the effect of the ratio of areas of copper (cathode) on the galvanic corrosion of iron (anode) in an aerated 3 per cent solution of sodium chloride in water gives these results:[1]

| Ratio of area of copper to area or iron | Metal loss (corrosion rate) milligrams per square decimeter per day |
|---|---|
| 1 | 600 |
| 5 | 2,000 |
| 10 | 3,400 |
| 15 | 4,900 |
| 20 | 6,000 |

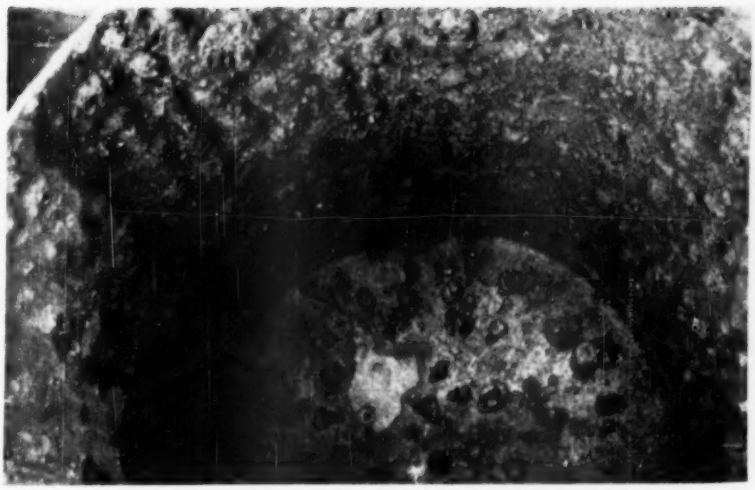
In actual practice the curve would be slowed down from this tabulation after some lapse of time because once corrosion began any break in the film would be expanded with a resultant reduced ratio. However, damage of the pit produced could be serious in terms of its depth in a thin walled tube or tank. The same cautions apply in the handling of vinyl plastic, rubber, or porcelain protective linings of tanks or equipment.

### Anodic Protection

Anodic protection becomes a valuable addition to paint or other dielectric coatings. A sacrificial metal such as magnesium, zinc, etc., reverses the flow of electrical potential to these small checks or holidays. Pitting and loss of the important metal, iron, is thus minimized and the life of the equipment prolonged.

A new composite protective patented rod has been discussed[3] that gives much longer life than the ordinary sacrificial anodic rods of magnesium or similar alloys in the protection of hot water heaters, tanks, etc. This type of rod treats the water instead of the tank metal. It is made in the form of a series of zinc slugs separated by brass washers and copper discs mounted on a stainless steel core. The electrolytic action takes place within the elements of the

rod. After four years of operation in electric water heaters that are already more than 10 years old, inspection showed the tank in good clean condition and a loss of only about 25 per cent of the weight of the protecting rod. Further growth of the rust tubercles present when the rod was put into the tank was arrested. Previously used magnesium rods were not too successful, even with protectively coated tanks.[3]



Combination of electrolytic and oxidization corrosion on the inside of a galvanized hot water tank

### Protective Paints

Galvanic corrosion has acquired an unduly bad name in many quarters. Some quite fantastic difficulties are attributed to it. It is held responsible for all failures not readily explained on other grounds. Although it is known that a choice of metals from points far apart in the galvanic series may produce serious effects, judiciously selected and protected bimetallic systems have given excellent service for many years.

Most of this section has been spent on background material in discussing galvanic corrosion. A knowledge of the factors affecting this type of corrosion is helpful when seeking the best coating for each job. Where galvanic corrosion is expected, much greater care must be exercised in the selection of the proper paint. Properties of the paints discussed in our November issue are minimal because galvanic corrosion makes even greater demands upon the pigment and film. Breaks in the film mean rapid and deep pitting. Oxidation must be inhibited or isolated not only because of its oxidation corrosion, but because of its capability of reducing depolarization and consequent accelerated galvanic action. The pigment should consist of materials that are anodic or at least neutral to the metal surface coated. One paint manufacturer[4] using a metallic zinc pigment claims that this paint supplies "a galvanic coating with a brush" as a "cold galvanizing compound offering true cathodic protection." Its properties are listed as 96 per cent zinc content in the film by weight; potential against calomel electrode of −1.13 volts in salt solution; color battleship gray. Siebert L. Miller[5] describes his success with lead suboxide paints on galvanized steel tower structures getting at least eight years of service against two to four years with various other commercial types of paints. This is the paint whose producer claims the formation of a metallic lead protective coating upon exposure to weathering and time.

Where anodic metals such as steel are submerged in water or lie underground subject to electrolysis of any type, cold bituminous or hot coal tar enamels form excellent coatings. These bitumastic coatings form few holidays or film breaks. They are neutral electrolytically with good dielectric resistance. Coal tar enamels form the bulk of paint protection applied to our long steel gas and oil lines. These enamels are applied hot, wrapped with coatings of felt, built up for over 50 years of life. They are generally flowed onto the cleaned and primed metal surface so that an adherent, thick insulating coating is obtained. They are water and soil resistant, withstanding abrasion, earth movement, and backfill impact without the formation of breaks or holidays.

Such coatings are generally tested by means of high voltage (10,000 V or move) spark coil gap testers in the field in order to insure continuity of film and no pitting upon burial. Lower sections of steel power transmission towers and other structures are heavily brushed with cold bitumastic paint as a ground coat, or with the newer aluminum-asphaltic compounds where the aluminum comes to the surface of the black paint to give an aluminum finish.

For short sections of structural metals, piping and cable that are buried or submerged, the use of high dielectric polyethylene or vinyl plastic tapes is becoming more popular. Frequently used are the 7 to 20 mil thick, half lapped, 2-in. or wider tapes, which give excellent galvanic protection, where severe service is demanded. Higher cost of the tape is more than offset by the saving in labor of application and by the extended life of the joint or section.

Chalking paints should not be used since any loss of film thickness and pigment is to be avoided.

### Summary

This section has tried to give some practical aspects of the complicated subject of galvanic corrosion as it affects average plant operations. The factors influencing galvanic corrosion have been discussed. It might be well to summarize the means that might be used, in conjunction with paints, to minimize galvanic corrosion:

1. Select the proper paints; clean the surface of the metal thoroughly, and use an inhibitive tenacious vehicle and pigment. In warm or tropical climates add a fungicide to the paint because fungi can live on some organic coatings and keep the metal moist.

2. Apply coatings with care, painting both the corroding and the nobler metals. A thick adherent film, especially with bitumastic coatings, gives higher dielectric resistance, and longer life than a thin one, other conditions being equal. Osmosis may be reduced.

3. Select combinations of metals as close together in the galvanic series as possible. Avoid combinations where the area of the less noble metal is relatively small. Make small parts, fastenings, rivets and bolts noble to the balance of the structure.

4. Insulate dissimilar metals as much as possible. If complete insulation cannot be achieved, paint and coat all joints in order to increase the electrical resistance of all circuits, reducing current intensity.

5. Where such decrease in electrical resistance is impracticable, make corrodable parts of greater thickness and weight to compensate loss in order to give desired life. Avoid joining with threads and the like, but rather braze joints, using nobler brazing alloys.

6. Utilize anodic protection where possible, along with coatings, such as magnesium or other sacrificial rods in water heaters in order to suppress or reverse galvanic currents to the metal to be protected.

7. In painting surfaces, or repainting them, change the color each time for the given year or date of repainting, to assure thoroughness of coverage and to serve as a calendar for maintenance, readily identifying the paint job and its life.

8. Keep all coatings in good repair.

#### References


[1] Corrosion Engineering Service, International Nickel Co.
[2] Underground Corrosion. U. S. Dept. of Commerce, National Bureau of Standards.
[3] W. C. Wilt, *Gas Age*, July 31, 1952, p. 21.
[4] Galvanite Corp.
[5] Union Electric Co.; NACE, *Corrosion*, April 1950.

# Conveyor Drive Developments

**Conveyor manufacturers and users have been alert to take advantage of the fluid drive, the dynamatic clutch coupling and the electronic speed control to improve flexibility of conveyor operation. Here are details of some of these drives and how they are used**

By W. H. EVERETT

Consulting Engineer

ONCE UPON A TIME the typical drive for a conveyor or elevator consisted of a cut pinion on the motor shaft — often of rawhide to eliminate the screech — a counter-shaft with cut spur gear, and, not infrequently, a second countershaft ahead of the head shaft. A necked soft steel shear pin provided protection against heavy overload, unless the operator substituted a tool steel pin without neck, as not infrequently occurred. With the development of the motorized reducer and the various types of enclosed speed reducers, the gear train disappeared. There have been some other vital developments since.

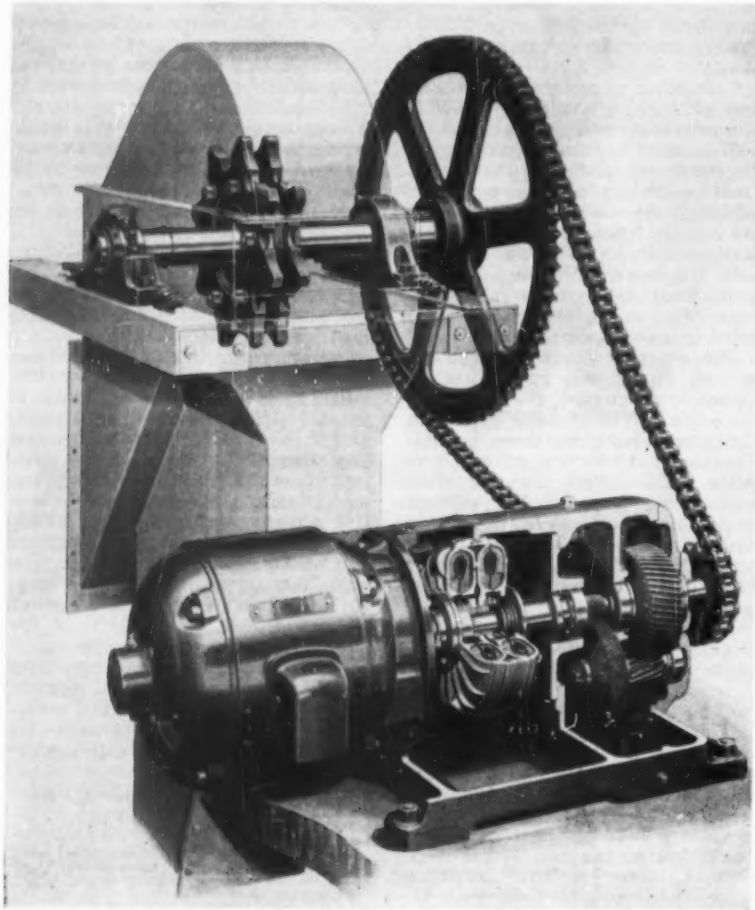


Fig. 1. Cutaway view of electrofluid gearmotor (as made by Link-Belt) showing fluid drive and double-reduction vertical gear set with integrally-mounted motor. Operation of the drive is explained in the text

**Automatic Torque Control Through Fluid Slip:** — About 1945 auto manufacturers introduced the hydraulic transmission. The conveyor manufacturers quickly recognized its possibilities in their field. Figure 1 shows the hydraulic clutch mounted on a motorized reducer. Figure 2 shows how the load is automatically picked up after the motor has attained about 70 per cent of full load speed. The motor continues to accelerate as the load builds up. There is slight slip, indicated by the gap between the "motor shaft" and "full load speed attained" curves, but this is of slight importance.

The hydraulic transmission or coupling is of particular importance with heavy inertia loads as involved in conveyors, crushers, Bradford breakers, and the like, which may at times be stalled. In addition to the smooth pick-up, it provides overload protection, for the transmission will pull only the safe overload and then will slip. Of course, the overload capacity of the motor cannot be used to restart a stalled unit if the required torque is beyond the design torque limit of the coupling. In that case, some of the load must be shoveled off.

**Automatic Torque Control Through Eddy Currents:** — What might be called the electric counterpart of the hydraulic clutch is the dynamatic clutch coupling. The operating principle is simple. If a magnetized rotor is revolved within a soft iron ring, Fig. 3, eddy currents are generated and the ring is pulled into step with the rotor with a torque dependent on the strength of the energizing current and the resulting magnetic flux. Under full load there is a slip of about 5 per cent at full speed between the driving and driven members. Energizing is by a 3-kw generator or a rectifier.

In an actual dynamatic clutch, Fig. 4, the input meter is driven at constant speed. The field coil is energized by direct current fed

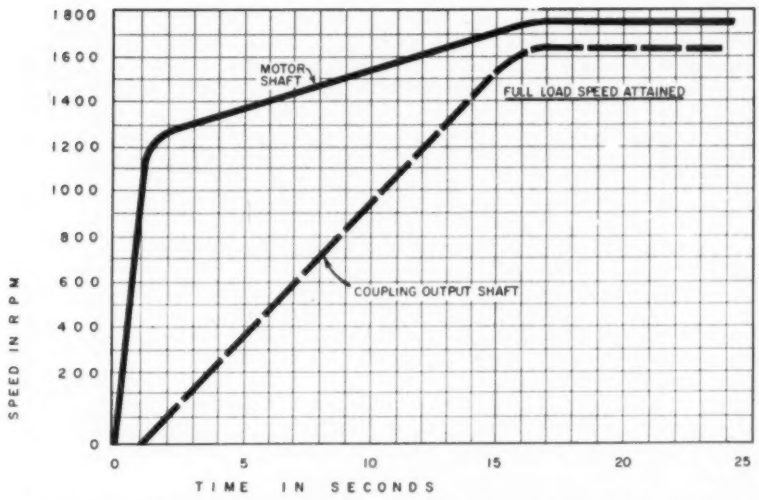



Fig. 2. This shows the operation of the hydraulic clutch coupling. This coupling permits the driving motor to attain 70 per cent full-load speed before it picks up the load. Small slip at full load is not important

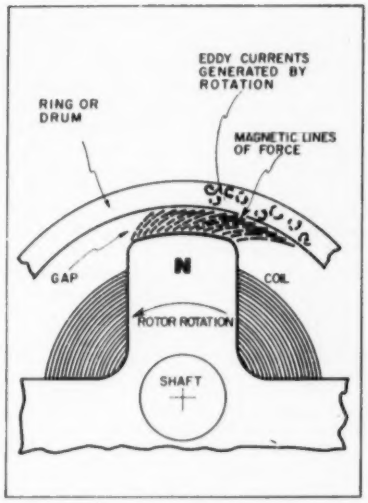



Fig. 3. Fundamental principle of the dynamatic clutch. Coil is fed with d-c through slip rings

through two slip rings on the output shaft. Both a difference in speed and a change in excitation affect the torque developed by the unit. The period for acceleration from no speed to full speed may be automatically controlled. For heavy duty belt conveyors, this period is from 30 sec upward.

In the drive of a heavy-duty belt conveyor, the dynamatic clutch is of striking importance. When a belt conveyor is started empty, there may be a power peak (belt pull) as the belt begins to move, as in Fig. 6. If the belt must be started while loaded, as after an emergency shut-down, this peak is far higher.

To meet this condition it is necessary to prolong the period of acceleration — often 30 sec or longer, otherwise the pull on the belt may cause the tension members of a wire cable high-tension belt to tear through the carcass by radial thrust as the belt rounds the drive pulley. These heavy duty belts represent an investment of $300,000 or more.

Drive of the heaviest duty belt conveyor to date is in a mine slope installation at Waltonville, Ill., with a 42-in. belt with 4200-ft centers, lift 862 ft, speed 625 fpm, capacity 1200 tph. The drive, shown in Fig. 7, is simple and effective. A 1500-hp synchronous motor drives through a dynamatic clutch and speed reducer. On the far end of the head shaft, a mine-type automatic brake prevents reversal should the belt stop when loaded. It releases whenever the torque builds up to the point at which the belt will start.

When the motor attains full speed,

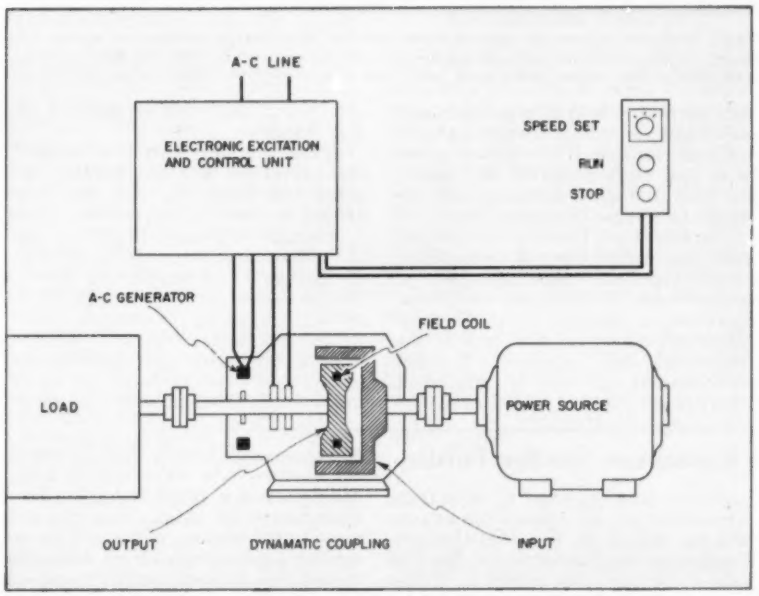



Fig. 4. Here is the way the dynamatic clutch coupling is usually controlled to produce wide speed range

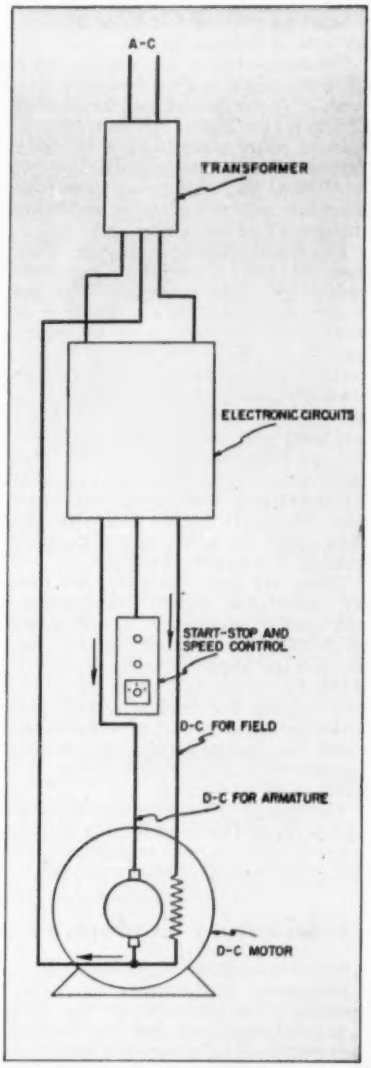



Fig. 5. Electronic speed control gives preset start

the coupling is slightly energized and gradually builds up the torque necessary to start the belt. Automatic electronic speed-control maintains a set speed within close limits. The coupling unit is water-gap-cooled and will dissipate the entire heat generated should overload conditions so demand; that is, at the 100-per-cent slip point with full-load torque transmitted.

A supplementary feature is the ability to operate at a controlled reduced speed to make the conveyor available as an escape route in the event of a disaster within the mine damaging the man-hoist. Here are some data on the drive:

| | |
|---|---|
| Hp to move empty belt | 88 |
| Hp to move load horizontally | 115 |
| Hp to lift load | 1045 |
| Total | 1248 hp |

Effective belt tension, 65,900 lb

Starting pull, 90,000 lb or 2150 lb per inch of belt width.

Contemplated is the addition of a 1,500-hp diesel engine which, in the event of power failure, can be coupled to the motor shaft, which then will operate as a generator (with eddy current clutch then slipped 100 per cent) to supply emergency power for the mine fan, man elevator and other emergency power needs.

**Electronic Variable Speed Control:** — Quite frequently, materials handling installations require changes in speed, either while operating or from time to time to suit changing conditions. Several types of standardized mechanical speed changers provide for variations of from 1 : 1 up to 5 : 1. Sometimes, however, a far wider range of speed variation may be required. Figure 5 illustrates an electronic speed changer available for installations requiring not more than 25 hp. It makes available the wide speed variation of a d-c motor from an a-c source of supply.

There are four elements: d-c motor, electronic panel, transformer, and control station. A speed range up to 20 : 1 is obtained by varying the voltage applied to the armature of the d-c motor, and up to 100 : 1 by also varying the field strength. The entire range of speed change is secured by manipulating one potentiometer dial handle just below the start-and-stop button.

The dial is pre-set for any desired speed. When the start button is then pressed, the motor accelerates to that speed quickly, because the armature current is held at maximum safe value and the motor always starts at full field voltage. If the pre-set speed is in the weak range of the motor, the field voltage is automatically reduced as the a-c begins to drop.

The electronic limiting circuits prevent the motor current from rising above a pre-set value regardless of motor load. If overload continues, however, a thermal overload relay takes the motor off the line. If the load should stall the motor, the armature current still will be limited to the pre-set value. Speed may be changed at any time by shifting the dial handle.

When the stop button is pressed, the armature is automatically disconnected from the line and connected across a line resister; then dynamatic braking brings the motor to a smooth stop. Tubes are readily changed and apparently have a life of three or four years under average working conditions. Such wide speed variation is never required in heavy-duty conveyor installations, but may at times be called for in the smaller conveyors and machine shops.

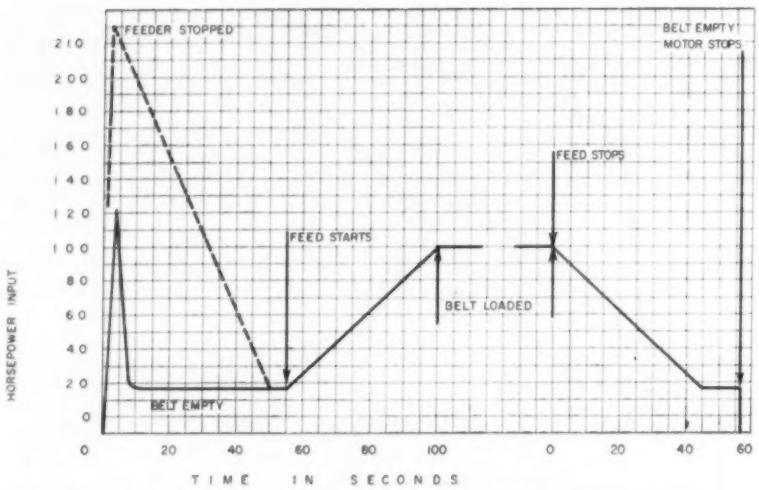



Fig. 6. Power input to an inclined belt conveyor handling 900 tph at 360 fpm. Dotted line shows when conveyor was started loaded after emergency shut-down. Feeder was stopped until belt had cleared

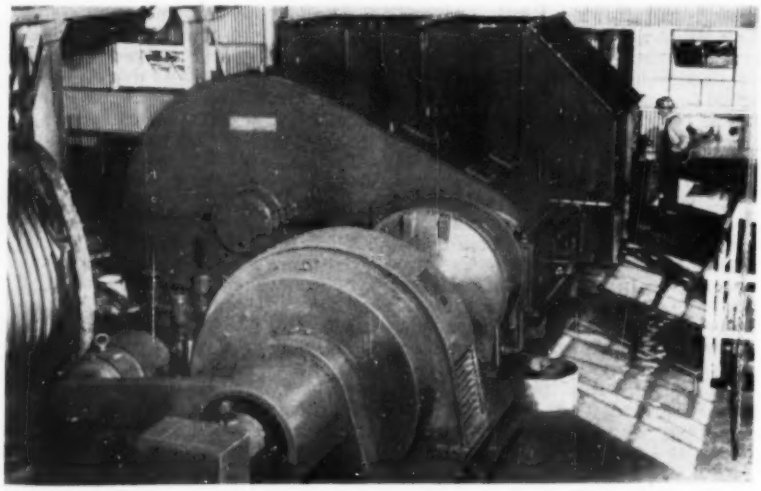


Fig. 7. Application of dynamatic clutch to heavy-duty mine slope conveyor, heaviest one to date. It includes 1500-hp synchronous motor, driving through water-cooled dynamatic clutch and double-reduction gear drive, a clutch exciter, cooling water control, and an automatic brake. (Photo courtesy Link-Belt Co.)

## Mid-Century Conference on Resources for the Future

RESOURCES FOR THE FUTURE, Inc., a non-profit corporation to foster research and education in the field of natural resources, has just formed the second of eight steering committees to help lay the groundwork for conference discussion by singling out issues in greatest need of attention. The work of all these committees will be pooled at the Mid-Century Conference on Resources for the Future to be held this month in Washington, D. C.

Resources for the Future, Inc., of 504 Stoneleigh Court, 1025 Connecticut Avenue, N.W., Washington, D. C., has received a grant from the Ford Foundation for conducting the mid-century conference, which will be attended by representatives of industries which extract, trade in, and use raw materials, and who are concerned with their long term future supplies.

# New Method for Determining $SO_2$ and $SO_3$ in Flue Gas

**This new method, with its versatile apparatus, was developed for use under field conditions. It features simplicity and speed plus high level of accuracy over wide range of gas temperature**

GREATLY IMPROVED method of analyzing flue gases in furnaces operating over a wide range of temperatures has been developed at the Research Center of Babcock and Wilcox in Alliance, Ohio. The new method was described by E. K. Diehl and R. E. Matty, both from the Research Center, in a paper presented in September to the American Chemical Society.

Two major advantages set the new method apart from others now in use: (1) It employs one standard solution of N/10 $H_2SO_4$, which can be kept indefinitely without harmful loss of strength, in place of the present unstable solutions; (2) It reduces the time between sampling and results from one day to one hour.

### Compact, Simple Equipment

No laboratory facilities are required, since the equipment, relatively simple in itself, needs only a small table, a source of distilled water and standard laboratory glassware to complete the set-up. A sketch of the equipment is shown in the accompanying illustration.

The sampling tube assembly consists of a 6-ft long $\frac{1}{2}$-in. ID quartz tube wound with nickel-chromium resistance wire, insulated and lagged, and enclosed in a water-cooled jacket. The resistance heating wire is set to maintain the sample temperature between 600 F and 700 F. This range is well above the dew point of $SO_3$, but is also below the temperature at which quartz catalytically oxidizes $SO_2$ to produce false readings.

Kaolin wool is used to filter fly ash from the sample. The filter plug is inserted in the quartz tube approximately 2 in. from the inlet, thus avoiding the possibility of deposition from the low-velocity sample within the tube. The Kaolin wool filter is placed cap-like over the end of the tube when sampling high-temperature regions of an oil-fired furnace. Thus it is kept at flue gas temperature.

Samples from the tube pass through a U-shaped bubbler containing 80 per cent isopropyl alcohol. This tube is electrically heated to 400 F at the entrance to prevent condensation of flue gas constituents before they contact the inhibiting solution.

An absorption train is connected to the outlet of the probe bubbler with glass tubing. The first bottle contains additional isopropyl alcohol for the completion of $SO_3$ absorption. This bottle is followed by a G-4 fritted glass filter which traps any $H_2SO_4$ mist which escaped from the absorption bottle.

Following the filter, two bottles contain $H_2O_2$ for the absorption of $SO_2$. After this, a final dry bottle acts as a settling vessel to protect the flow meter from mechanical carry-over of the peroxide solution.

A rough calculation of the amount of sulphur to be absorbed can usually be made prior to the run and absorbents increased by adding bottles to the train to prevent saturation if necessary. Thus, no saturation indicator (such as an iodine solution) is required.

Flue gas samples are drawn through the absorption train by a vacuum pump and measured by a flow meter (located after the dry bottle). A bypass and needle valve provide the fine adjustment necessary for controlling the flow through the train.

### Turbidimetric Analysis

A turbidimeter constitutes the basis for sulphate and total sulphur determination, and a special portable unit with a self-contained power source was built for this purpose. Specially prepared test solutions are placed in a Nessler tube (part of the turbidimeter) and a beam of light is passed through the sample to a photoelectric cell at its bottom. The amount of light transmitted, indicated by a microammeter connected to the cell, is a measure of the absorbed gas.

Normally, samples are drawn off over a period of one hour. After the sample has been drawn, at the rate of approximately one liter of gas per minute, the following two samples are prepared:

1. This is the sample from which the $SO_2$ content is determined. To obtain this, rinse the bubbler, filter, and the first bottle in the absorption train with 80 per cent isopropyl alcohol into a 250 ml (or 500 ml) volumetric flask and dilute to the full volume with additional 80 per cent isopropyl alcohol.

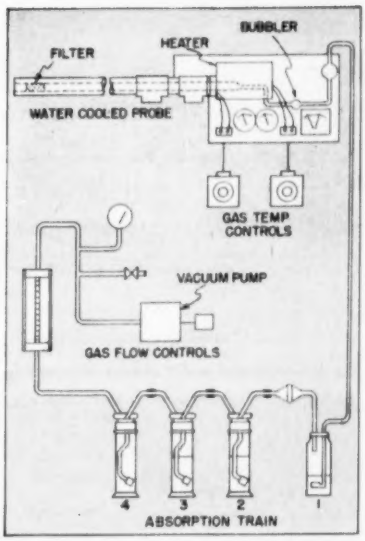



Fig. 1. Schematic of equipment arrangement for turbidimetric analysis of flue gas. Equipment is compact; requires only a small table for mounting

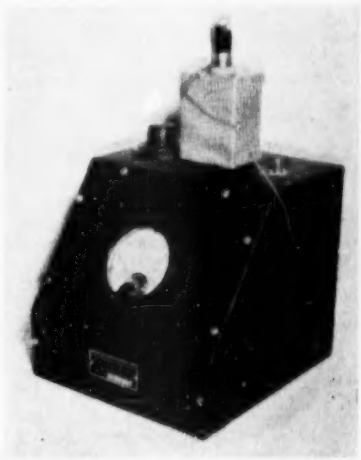


Fig. 2. Turbidimeter used in new flue gas test

2. This is the sample from which the total sulphur content is determined. To obtain this, rinse the peroxide bottles with distilled water into a 250 ml (or 500 ml) volumetric flask and dilute to the full volume with distilled water.

### $SO_3$ Determination

Place 45 ml of sample No. 1 in a 50 ml Nessler tube. Add 5 ml of a solution of the following reagents and mix by shaking: by volume, 72 per cent C. P. isopropyl alcohol, 18 per cent distilled water, 10 per cent conc. HCl. Next, add and shake slowly for 30 sec 1 ml of 20 per cent $BaCl_2$ solution. Allow sample to stand for five minutes.

While this true sample is standing, prepare a "blank" sample by adding 5 ml of the first solution and 1 ml of distilled water to 45 ml of the sample. This is placed in the turbi-

*(Continued on page 118)*

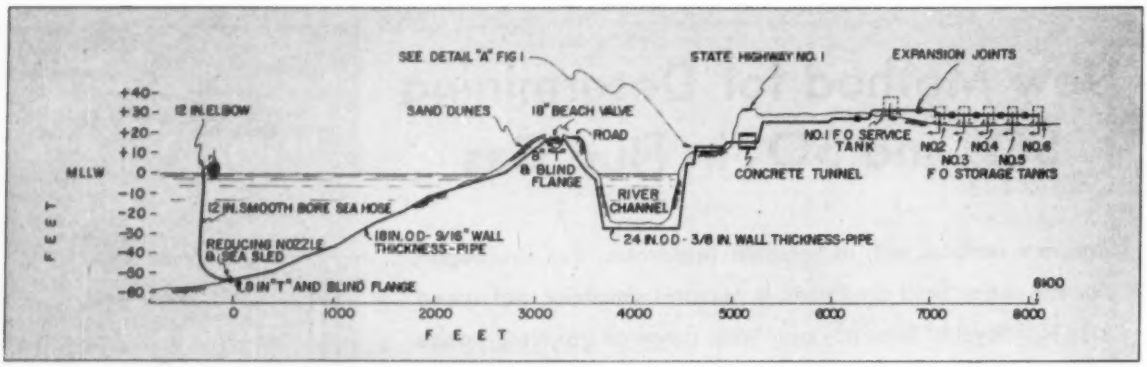



Fig. 1. Compressed profile of submarine pipeline. When ship not discharging, hose lays on sea bed; when needed it is hauled up by rope tied to hose buoy

# Offshore Oil Delivery Saves Time and Money

**For this plant near deep water, unloading fuel oil direct from tankship to storage has many advantages. Here are its main features**

LOCATION and capacity of P. G. & E.'s Moss Landing Plant in California made it desirable to deliver fuel oil of the highest commercial viscosity from large tankships through a submarine pipeline approximately 1¼ miles long to the storage tanks of the plant.

Though the use of submarine lines is not new, this installation included several unknowns for which there was very little prior experience, particularly as it was proposed to unload bunker fuel of 175 SSF at 122 F viscosity without the benefit of line recirculation. In ASME Paper No. 53-SA-30, presented in June, 1953 at Los Angeles, S. P. Johnson, Standard Oil Co. of California, and E. A. Salo, Technical Engineer, Pacific Gas & Electric Co. discuss in some detail the economic size of the line and give data to illustrate their experiences in displacing cold oil from the line. They also describe the radio-communication facilities of the installation, cathodic protection of the buried line, and general maintenance problems of the equipment.

Figure 1 shows a profile of the installation. The main underwater line is 18 in. OD, 9/16 in. wall thickness pipe, protected with 5/8 in. of Somastic coating. This main line terminates at the sea end in a transition member that necks down to a standard 12-in. flange, to which is connected 200 ft of 12-in. ID flexible hose which lays on the sea bed when not in use, but when required is pulled to the surface by a hemp line tied to the hose buoy.

The hose is made from neoprene for oil resistance, with six plies of heavy duck reinforcing, then two braided-steel wires, wound spirally opposite and incorporated in the carcass, the outer surface being covered with an abrasion-resistant neoprene cover.

Communication between ship and shore is by short-wave radio. The plant has a 15-w base station, and a 15-w portable plug-in set is used on the ship. Standby battery operated sets are kept at the plant.

The cathodic protection for the submarine line has some interesting features. Though the Somastic coating gives excellent protection when intact, it is subject to possible damage during installation which could result in expensive repairs and delays.

As shown in Fig. 2, an electrically insulated section is provided in the 24-in. line at the shore end, and an electrode is fitted to the pipe just beyond the insulator on the seaward run. This electrode serves as the negative terminal of the cathodic-protection system. A buried anode, located below the permanent moisture level, is used for the positive electrode. The anode is a graphite cylinder, 6 in. diam and 6 ft 8 in. long, placed vertically in an 18 in. diam, 18-gage black-iron can. Space between can and anode is tamped full of alkaline-graphite fill. The arrangement is shown in Fig. 2.

An 8-v, 8-amp rectifier is installed on a nearby pole to give the necessary positive soil protection with respect to the pipe. A cathodic protective current of 3 amp is necessary to protect the pipe adequately.

The authors believe the Moss Landing arrangement can handle fuel oil of viscosity as high as 300 SSF at 122 F without difficulty.

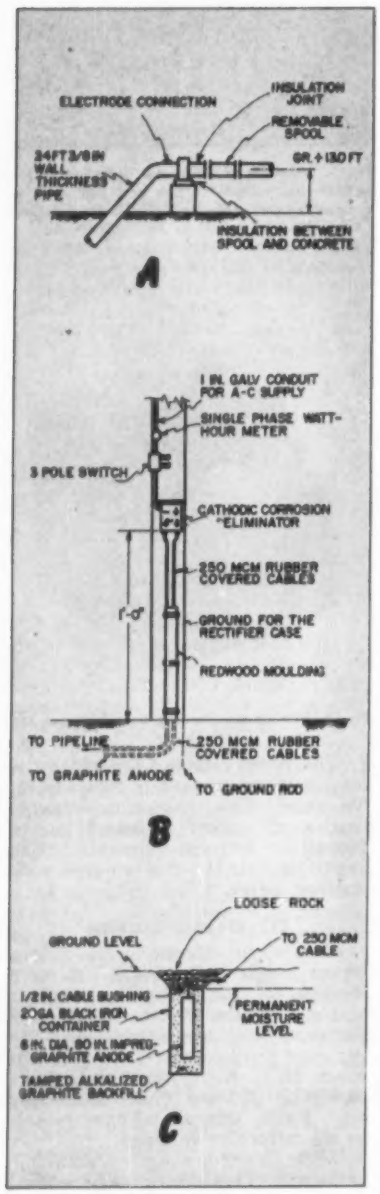



Fig. 2. Cathodic protection for pipeline. A, Detail of insulated joint; B, Rectifier connections for cathodic current supply; C, Anode construction

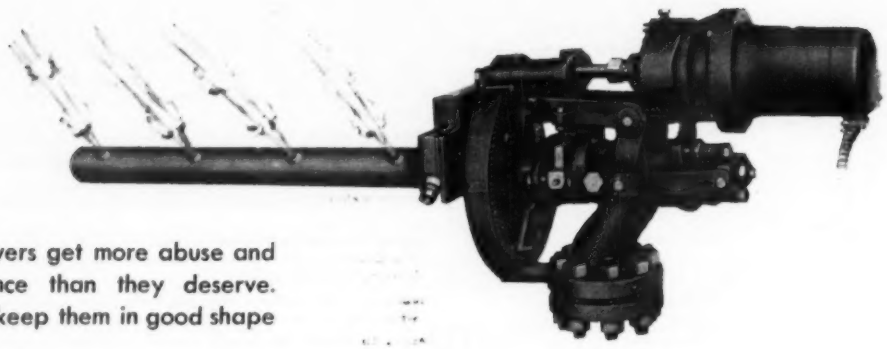
# Non-Destructive Testing Methods in Use Today

**During the past few years great progress has been made in the technique of non-destructive testing of materials. The list below shows the present state of this rapidly developing branch of engineering**

| No. | Main Group | Sub-Group | Principal Applications |
|---|---|---|---|
| 1 | Proof Loading | — | A certain and direct method, usually confined to the final stages of production. |
| 2 | Surface Crack Detection and Examination | Acid Etching. | Simple, quick and inexpensive method that can be applied on site to steel castings and forgings. |
| | | Paraffin and Chalk Method. | Similar advantages to acid etching, but not so sensitive. |
| | | Magnetic Powder and Ink Methods. | Very sensitive method for detecting cracks, non-magnetic inclusions and folds at or near the surface of ferro-magnetic materials. |
| | | Penetrant Fluorescent Ink and Dye Methods. | Not as sensitive as magnetic method, but can be applied to non-magnetic as well as magnetic materials. |
| | | Sulphur Printing. | Extensively used for revealing the presence of sulphur segregates in steel castings and forgings. |
| | | Surface Finish Measurement (Stylus Method). | Provides an accurate means for measuring roughness on the surface of bearings and similar components. |
| | | Surface Finish Examination (Projection Method). | A simple method for examining and comparing a wide variety of surface textures. |
| 3 | Internal Flaw Detection | Radiography (X-Ray). | The most direct and widely used method of non-destructive testing. Particularly valuable for the examination of pressure vessels and construction welding, castings, etc. Fine cracks and laminations not easily detected. |
| | | Radiography (Gamma-Ray). | Usual sources are radium, radon, and artifically produced radioactive isotopes. Extremely useful where high penetrations are required in confined situations. |
| | | Radiography (High Voltage). | Resonance Transformers, Van de Graaff Generators and Betatrons offer possibilities where high penetrations and short exposures are required. Linear accelerators, giving greatly increased X-ray outputs, offer possibilities in the future. |
| | | Sonic Methods. | Finds use for checking soundness of locomotive wheels, detecting loose rivets and examination of butt welds. |
| | | Ultrasonic Methods. | Will detect fine cracks and laminations not shown by radiography. Particularly useful for detecting and locating defects in large masses of metal. Also widely used for examining welds. |
| 4 | Magnetic and Electrical Testing | Magnetic Sorting Methods. | Provides a sensitive and rapid means for the routine checking of small steel components for variation in composition, hardness, etc. |
| | | Direct-current Methods. | Can be used for the detection of laminations, poorly brazed joints, defective butt welds, etc., in ferrous and non-ferrous metals. A clean smooth surface is essential. |
| | | Eddy-current Methods. | Applied principally to ferrous materials. Provides a useful method for revealing defects in welds. |
| | | Electronic Comparators. | Used extensively for routine dimension comparison; component inspection for composition, hardness and cracks; stress/strain analysis; plating and coating inspection, etc. |
| 5 | Physical and Chemical Tests and Analysis | X-Ray and Electron Diffraction Techniques. | Provide a direct means for determining the atomic and molecular arrangement in engineering materials. At present, mainly confined to research, but undoubtedly have great possibilities in non-destructive testing. |
| | | Spectographic Analysis. | Provides a precise means for determining the chemical composition of materials. Use of method mainly confined to specialists. |
| | | Spot Tests. | A qualitative test method particularly useful for detecting such elements as nickel, chromium, manganese, etc., in welds. |
| | | Print and Electrograph Methods. | A convenient and simple method for the rapid testing of the composition of metal alloys. Also reveals distribution of particular constituents over surface of metal. |
| 6 | Stress, Vibration Detection and Measurement | Strain Gages (Resistance). | Investigation of stress systems in welded pressure vessels. |
| | | Strain Gages (Probing). | Provides a convenient means of indicating the distribution of stresses in high-pressure vessels. |
| | | Strain Gages (Counting). | Valuable where the result is required in the form of statistical analysis. Mainly applied to aircraft, but could find use in the investigation of ships' hulls, boilers, etc. |
| | | Strain Gages (Acoustic). | May be applied to rough surfaces such as masonry and corroded steel structures. |
| | | Vibration Detection & Measurement. | Widely applied to steam turbines, gearing, propeller shafts, rotors, etc. |
| 7 | Mechanical Measurements and Testing | Determination of Hardness by Micro-Indentation Method. | Determination of hardness variations in localized areas, such as welds, platings, etc. |
| | | Determination of Elastic Constants (Resonant Frequency Methods). | Enables Young's modulus of a metal to be determined without applying tensile stress. Applicable only to simple shapes. |
| | | Determination of Elastic Constants (Velocity of Propagation of Ultrasonic Wave Methods). | Has important possibilities for the investigation and precise measurement of the elastic properties of materials at elevated temperatures. |
| | | Thickness Measurement (Transformer Method. | Useful for measuring thickness of non-magnetic coatings (paints, sprayed metal, vitreous enamel, etc.) on magnetic bases. |
| | | Thickness Measurement (Reluctance Variation Method). | Useful for measuring thickness of non-magnetic coatings on magnetic bases. Readings can be taken from edges, curves, as well as planes. |
| | | Thickness Measurement (Capacitance Method). | Used principally for measuring dimensional changes in alloys at elevated temperatures. Can also be used for determining thickness of non-conducting layers on metal bases. |
| | | Thickness Measurement (Inductance Method). | Useful for measuring non-conducting layers on non-magnetic bases. Instruments require calibration for different metal bases. |
| | | Thickness Measurement (Resistance Method). | Can be used for measuring thickness of ships' plates and boiler tubes. Applicable to ferrous and non-ferrous metals. |
| | | Thickness Measurement (X-Ray Absorption Method). | Can be used for continuous thickness measurement of cold or hot-rolled steel strip and plate. No contact with material necessary. |
| | | Thickness Measurement (Gamma and Beta Radiation Absorption and Back-scattering Methods). | Can be used for continuous measurement of thickness on metals, paper, plastics, etc. No contact with material necessary. No large, expensive equipment required. |
| | | Thickness Measurement (Ultrasonic) Pulse and Resonance Methods). | Can be used to measure thicknesses up to several feet. Particularly suitable where one side only is accessible. Useful for detecting corrosion in ships' hulls, pipelines, pressure vessels, etc. |

**Courtesy, *The Steam Engineer*, London, England. (Prepared by C. C. Gee)**

# Preventive Maintenance for Soot and Slag Blowers



Most soot blowers get more abuse and less maintenance than they deserve. Here's how to keep them in good shape

**By S. F. WALLEZE**

Copes-Vulcan Division
Continental Foundry & Machine Co.

Fig. 1. Typical rotary type soot and slag blower

WITH ANY equipment used in the power plant, preventive maintenance should start with its purchase. It is always wise to:

1. Buy quality equipment from a reputable salesman. You will find him personally interested in your getting good service from his products.

2. Make sure factory-trained service engineers are located within a reasonable distance from your plant. These engineers should call periodically to inspect your equipment, make recommendations, and outline and inaugurate preventive maintenance programs. Many manufacturers provide no-charge initial inspections before equipment goes into service, if properly notified that installation is complete. They also make regular inspections throughout the life of the equipment at no charge, if the manufacturer controls the scheduling of these inspections. In addition, they always have available, at nominal cost, factory-trained engineers to supervise both erection and maintenance of this type of equipment.

3. Make sure the equipment purchased is the best available for the application. False economy in purchasing often shows up in high operating cost.

4. Make sure that spare parts are readily available from factory, regional warehouse, or other source.

These things are most important with soot and slag blowers, which generally receive as much abuse as any equipment in the power plant. They are subject to extreme temperature changes. They must go for long periods with little or no chance for maintenance because of the operating demands. Their replacement parts are often expensive because of their service life.

### Equipment Types

Most mechanical soot and slag blowing equipment falls into one of three major classes:

**1. Rotary:** An element with nozzles located for proper distribution of the blowing medium, which is admitted by the operating head. The head rotates the element about its own axis. It usually contains its own automatic shut-off valve. The element is secured in its location by hangers or bearings. Application of Rotary equipment is usually limited to locations where gas temperatures are below 1800 F continuous. This equipment can be manual or power-operated, and can use air or steam as the cleaning medium. See Fig. 1.

**2. Short Retractable:** Sometimes called gun blowers, wall blowers or deslaggers. Extends and retracts one or two feet. Used on small boilers where gas temperature is too great for Rotary blowers. Used extensively on large steam generators as wall deslaggers, their cleaning ability contributing to the control of steam temperatures. Can be manual or powered by air or electricity. Can use steam, air, water or any combination thereof as the cleaning medium. Figure 3 shows an example of this type.

**3. Long Retractable:** Used where high temperatures would make maintenance of Rotary equipment a serious problem, and where Short Retractables would have inadequate cleaning range. Because of size and travel, Long Retractables should be driven by air or electric motors. Steam, air, water or any combination thereof may be the cleaning medium. Figure 5 shows this type in operation.

First on the list of preventive

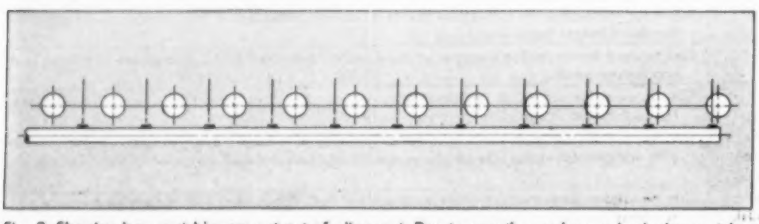


Fig. 2. Showing how soot blowers get out of alignment. Due to growth, nozzles are impinging on tubes

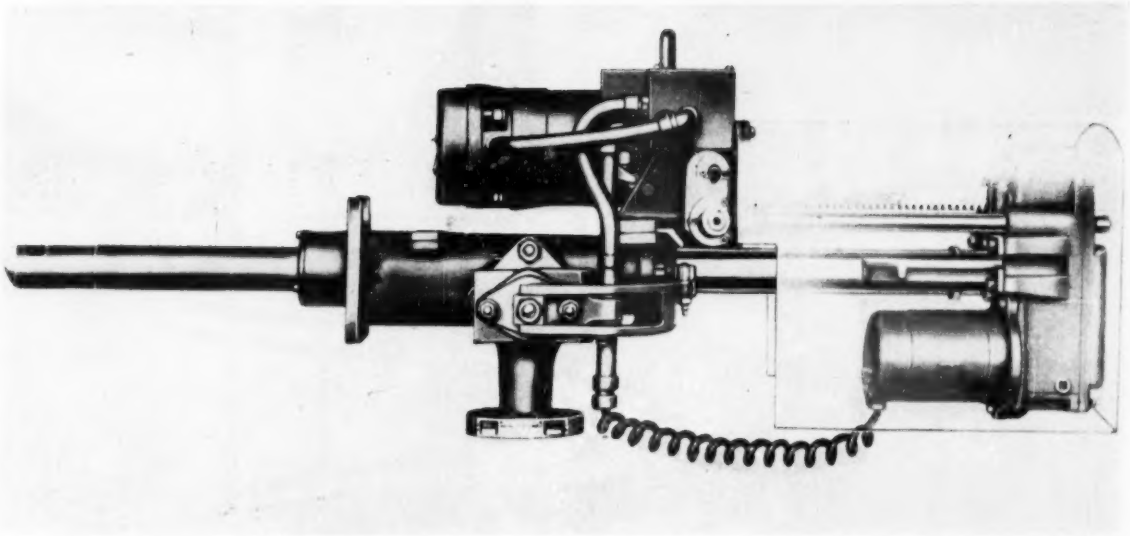


Fig. 3. Short retractable soot blower. It extends and retracts one or two feet. Used for small boilers where temperatures are too great for rotary blowers

maintenance procedures is proper operation of the soot or slag blowers. The manufacturer's service engineers can make detailed recommendations for your installation, but these important check points generally apply:

1. On steam-blowing jobs, drain valves should be fully open during warm-up periods before blowing. Take enough time to have absolutely dry steam before closing the drain valves. Aside from extreme temperatures, condensate is the largest single trouble-maker in any boiler cleaning system. Condensate in the system will cut valves; warp, distort or fracture elements; reduce packing life; in some cases contribute to the corroding of piping, causing premature failure; and it promotes tube cutting.

2. All units should be in operating condition at all times. Loss of one blower could permit plugging in that area. This would divert hot gases to the next unit, resulting in premature failure of the element.

3. On hand-operated systems, rotation of the element should be slow, even and continuous during the blowing cycle. This uses the blowing medium effectively and without waste. On automatic systems, best speed for Rotary units is 1 to 2 rpm, with slower speeds on the more difficult jobs. These speeds can also be applied to hand-operated systems with equally good results.

4. Operate blowers in proper sequence, following the gas flow unless specific instructions have been given to the contrary. Operate them at regular intervals or often enough to keep exit gas temperatures reduced to the proper minimum. Blowing intervals must be adjusted to load, fuel and firing conditions. If gas is burned for extended periods, making the use of blowers unnecessary, rotate the blowers at least once a week to prevent binding, "freezing" or warping of elements and operating heads.

5. Heating boilers during summer months, or boilers on bank or very light loads, can become badly fouled and require regular cleaning, even though exit gas temperatures register no increase.

Tube cutting is one of the more common results of improper maintenance or operation. It can be alleviated by:

1. Avoiding use of excessive blowing pressures or jet velocities for the cleaning job to be done.

2. Eliminating condensate from the system.

3. Assuring proper positioning of elements and nozzles with respect to tube surfaces by regular, frequent and thorough internal inspection.

4. Following suggestions from boiler manufacturers, boiler inspectors and field service engineers of the soot blower manufacturer. Consult service manuals frequently.

Elements constitute the bulk of initial and repair costs on any Rotary system. They are generally available in four ranges:

1. Plain steel for use where temperatures do not exceed 900 F.

2. Plated or processed steel elements for use where the temperature range is from 900 to 1500 F.

3. High-temperature alloys for 1500 to 1800 F continuous range or 1900 F intermittent service.

4. Special elements for recovery boilers, oil stills, reverberatory furnaces and other special applications.

Where high maintenance and replacement problems exist, consult the manufacturer's representative for a more suitable element or equipment to reduce costs.

Some alloys are represented as having higher temperature-resistant qualities. However, the determining factor is the ultimate strength at the temperature range in which it is used. This may be only 40 per cent of what it would be if used 200 F lower. High temperature resistant qualities are not enough, as the element is quickly and frequently chilled by the blowing medium. Consult the sales or service representative for guidance in these selections.

Equally important for proper op-

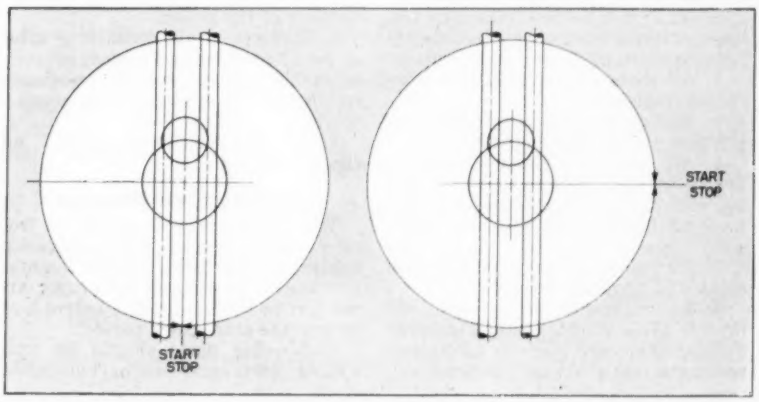



Fig. 4. Blowing pressure and moisture content are highest at starting. These should be dissipated along the tube lane (left hand diagram) and not perpendicular to the tube bank (right) to prevent tube cutting

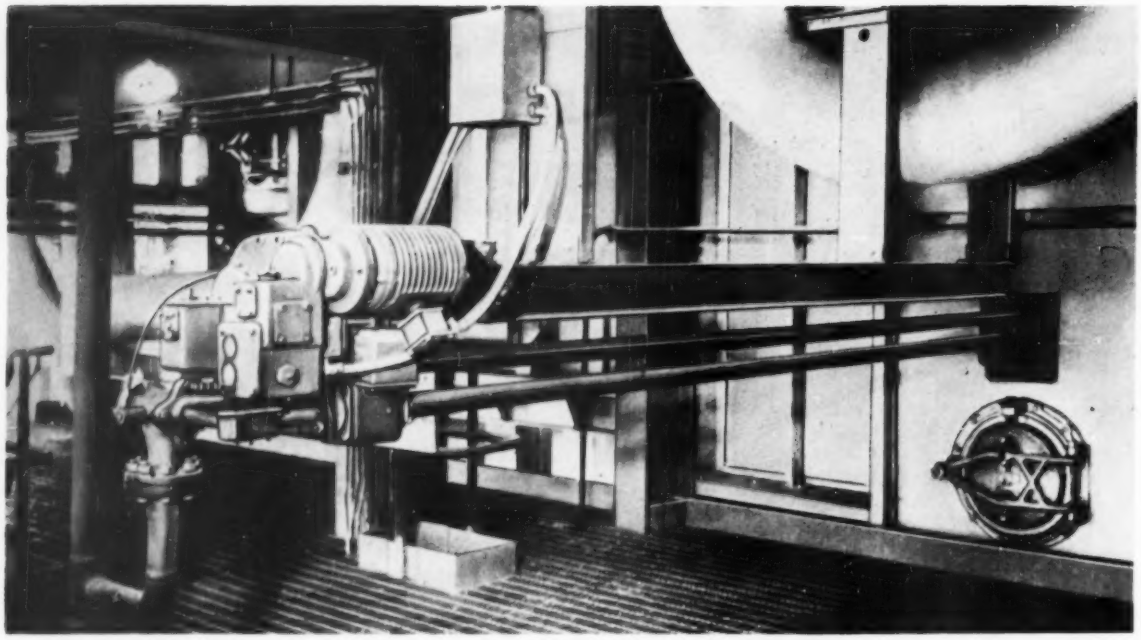


Fig. 5. Long retractable soot blower, used where short retractable has too small a range and where the temperatures are too high for rotary type blowers

eration of soot blowers are external maintenance during operation and internal maintenance during outages.

The success of the maintenance program depends on proper instruction of all personnel so they will understand thoroughly the operation of the equipment on which they will work. Soot blower manufacturers gladly provide such instruction through their field service engineers or sales representatives.

Operating personnel should be instructed to report immediately to the Maintenance Department any difficulty encountered during operation.

### External Maintenance

**Rotary Soot Blowers.** These points can be checked while the boiler is in service:

1. Competent maintenance personnel should be required to follow and observe each and every soot blower through its operating cycle on a schedule. Frequency of such inspection should be determined by the size and importance of the soot blower installation to proper boiler operation.
2. All steam leaks should be corrected immediately.
3. All valves should seat tightly to prevent wire drawing effects.
4. All packing glands should be drawn tight enough to prevent leakage without binding or breaking down packing fibres from excessive pressure.
5. All moving parts should be clean and properly lubricated.
6. Lubricators and filters in air lines to air motors should be checked at least once each week to be sure oil reservoirs are filled and feeding correctly.
7. With electric-driven installations, general rules for care of electrical equipment and industrial controls should be followed.
8. With any lubricant, manufacturer's specifications for correct types, amount and frequency of application should be followed closely.

**Retractables** (Short and Long). All points under external maintenance for Rotary equipment apply equally to Retractable units. Retractables are usually heavier and need more dependable motor drives. More consistent and thorough attention should therefore be given to motors, gear boxes and lubrication. These additional points can be checked while the boiler is operating:

1. Be careful when mounting Long Retractables. Where outboard bearing or boiler end of the blower is supported by the boiler, only one other point should be attached to structural steel. If more than 2-point support is used, twisting and binding of the blower can occur with boiler load changes because of expansion characteristics of the boiler.
2. Surfaces of the retracting tube or feed line running through or over a packing gland should be clean, smooth and free from burrs, cuts or scoring.
3. All moving parts should be cleaned regularly.

### Preparing for Outages

Where boilers are subject to frequent or extended outages, as in heating or processing plants, maintenance can be reduced by proper attention to the equipment before and during the shut-down period.

1. Moving parts should be well coated with rust-preventive lubricants.
2. Mechanical units should be covered for protection against moisture or excessive dust.
3. Parts not made of rust-resistant alloys should be protected by a rust inhibitor or stored until the equipment is again needed.
4. Feed tubes, if carbon steel, should be extended and rust preventive applied.
5. Inspections and repairs should be made immediately when the boiler is shut down to assure proper operation when the boiler is put back into service.

### Rotary Soot Blowers

**General Inspection**

1. Make sure valve mountings or head supports are secure. Loose mounting permits change in careful internal alignments.
2. Check operating head and valve to be sure they are functioning properly mechanically, and can rotate without binding.
3. Make sure mechanical parts are clean and free of dirt and rust.
4. When the blowing medium is steam, obtain the driest possible steam at maximum pressure. Proper draining of the piping is of prime importance. Steam piping should be insulated for safety as well as economy, and to reduce formation of condensate in the system.
5. To keep piping stresses from developing, provide proper pipe hangers. Piping should never depend on the soot blower for support. Improper support practices often cause elements to bind during rotation.
6. Periodically dismantle any condensate traps used on steam systems. If a drain valve is used instead of a trap, make sure seat partition has been drilled, and check valve to be sure it is in operating condition.

(*Continued on page 121*)

Power Engineering's

# PRACTICAL ENGINEER and ELECTRICIAN SECTION

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# Could You Cure This Water Hammer?

**One of the questions published in our August issue has proved more of a problem than it seemed at first. Readers who did not follow it in the Q and A section may be interested in this review**

## Here is the question as it was published

SEVERAL MONTHS AGO, we installed a steam-jet refrigeration system with a barometric condenser. The barometric condenser and tail-pipe were installed as shown on the attached sketch. The usual secondary ejector and inter-condenser with a 3rd stage dry ejector are installed on the barometric condenser.

After start-up of the system, a distinct and loud water-hammer was present in the tail-pipe. The source of the hammer was believed to be in the immediate area of the 90 deg base elbow. The water-hammer was not present when the vacuum in the condenser was less than 27.8 in. Hg, nor was it present when the steam ejectors were turned off and condensing water was allowed to run through the tail-pipe alone.

Except for this water-hammer, the operation and performance of the system were entirely satisfactory, but since a 27.8 in. Hg vacuum in the condenser was insufficient to provide the evaporator with the 29.75 in. Hg vacuum necessary to cool the chilled water to 40 deg without changing the compression ratio of the steam-jets, we were faced with a choice of: (a) accepting the water-hammer, (b) changing the steam-jet in order to get an increased compression ratio, (c) moving the entire installation so that the tail-pipe would drop vertically for its entire length from the barometric condenser to the hot well, or (d) changing the two 90 deg ells to form a very slight angled change in flow at the bottom of the hot well.

Neither of the two solutions (b) or (c) were acceptable because of the expense of making either change plus the greatly increased operating expense if change (b) were made.

We believed the cause of the hammer to be due solely to the two 90 deg turns at the bottom of the tail-pipe, but also gave consideration to the horizontal run leaving the condenser. It was our belief that entrained air coming out of solution was being drawn back up the tail-pipe and since the de-aerating would be more pronounced at the two lower 90 deg ells, as well as being below the water level in the tail-pipe, we felt sure that these air bubbles would form at the ells, grow larger with time and then be burst by the force of the dropping water, causing the hammer-like sounds. The hot well was originally sealed, but installing a valved vent with a pressure gage indicated that the hot well was not acting any differently from a normally open one.

The test vent shown dotted on the sketch was installed in an attempt to draw the air out of the tail-pipe as it escaped from the water. This was to no avail. The pressure gage installed inside the heel of the base elbow showed a pressure fluctuating between slightly positive and slightly negative. These pressure changes could not be synchronized with the "nammer". The 6 in. vent shown at the top of the tail-pipe was originally a 2 in. vent. Increasing this vent had no effect on the hammer.

In addition to the possible solutions mentioned above, two other means to remove the "hammer" were suggested: (1) Install a larger barometric condenser, and (2) restrict the flow of condensing water at the hot well outlet, thus causing the water-level in the pipe to rise and decrease the free fall height of water, as well as raise the level in the pipe where the vacuum changes to atmospheric pressure or higher.

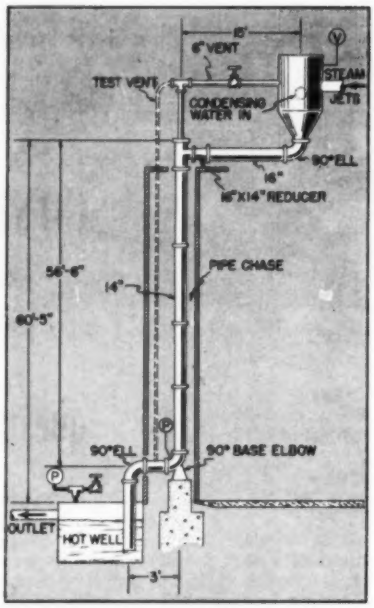



Fig. 1. This diagram was published in August with E. E. M.'s question about his water hammer problem

We would appreciate the opinion of your readers as to what is causing the water-hammer and how it can be eliminated.

## Here is the latest report received from E.E.M.

THE PROBLEM concerning water hammer in the tail-pipe of a barometric condenser, which you so kindly published in your August issue, has not as yet been completely solved.

I am writing again to inform you of the progress we have made and of the future steps under consideration so that your readers may be brought up to date and in the hope of obtaining some diversified opinions.

We removed the two 90 deg ells at the base of the tail-pipe and installed two 22½ deg ells, as shown in Fig. 1.

With the 22½ deg ells installed, we were successful in removing the hammer up to a certain point.

With a vacuum of 28.4 in. or less Hg in the barometric condenser, we had no water hammer, and at this vacuum we were able to maintain a chilled water temperature of 42 deg F in the evaporator.

As the condensing water supply temperature rose above 70 deg F, it was necessary to increase the flow to the barometric in order to maintain the required minimum vacuum. With this increase in flow, the water hammer returned and we are relatively in the same position we were before.

The probability of "flashing" in the tail-pipe due to the water temperature leaving the condenser being at the temperature corresponding to the boiling point at the pressure existing has been checked pretty thoroughly and has been rejected, at least until more definite data shows otherwise. Lack of cooling or condensing ability (due to insufficient surface or water) would undoubtedly cause this condition, and there does not appear to be any such lack. The preceding statement presumes that only vapor is

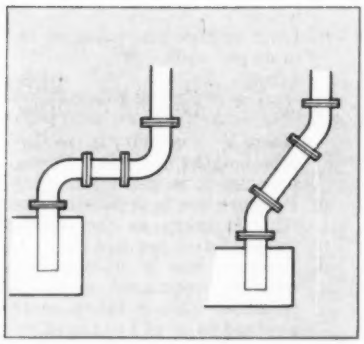


Fig. 2. Two 90 deg ells (left) at base of pipe in Fig. 1 were replaced with two 22½ deg ells (right)

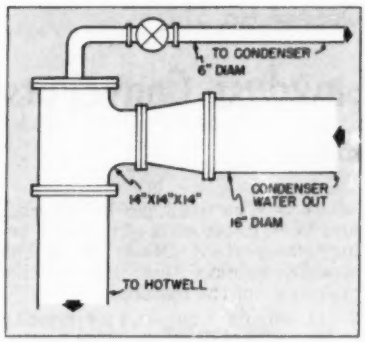



Fig. 3. Opening or closing the 6 in. diam vent pipe to the condenser had no effect on the hammer

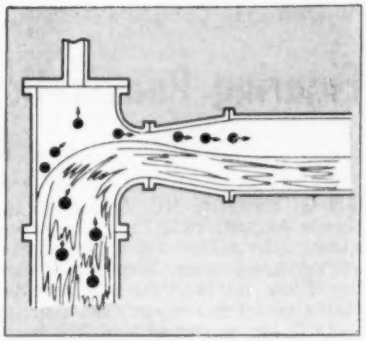


Fig. 4. With small flows there is enough space between water and pipe to let air and vapor escape

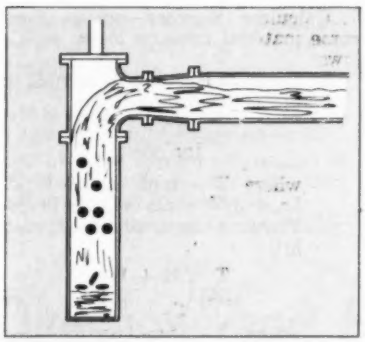


Fig. 5. With heavy flows water could form a seal and prevent venting of entrained air and/or vapor

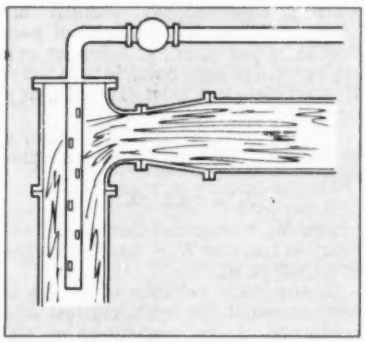


Fig. 6. Suggested way to cure hammer by using a slotted pipe to vent air trapped under water seal

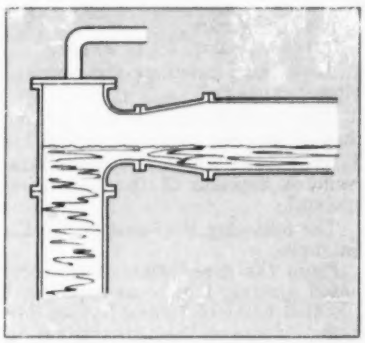


Fig. 7. Another suggested cure is to raise tail pipe water level by restricting the flow of water

causing the hammer — it could also be air. If it is air, the effect would be the same, but the secondary ejectors are apparently removing all the air.

As I mentioned above, when we removed the 90 deg ells, we were able to operate at a vacuum of 28.4 in. Hg without water hammer with a given water flow. Before the 90 deg ells were changed, we could not operate at vacuums greater than *27.8* in. Hg without having the water hammer.

In mentally reviewing the problem certain questions appear important:

Could air or vapor, or both, be mechanically entrained in the water leaving the condenser and be carried down the tail-pipe as far as the first 22½ deg ell where turbulence releases these "bubbles" which are then "imploded" (opposed to exploded) by the falling water?

Why should increasing water flow and increasing the vacuum beyond 28.4 in. bring on the hammer?

Since originally with 90 deg ells, we could not exceed a 27.8 in. Hg vacuum without creating a hammer, and now with the 22½ deg ells we cannot exceed a 28.4 in. Hg vacuum, the effect of any variation from a straight tail-pipe may be such as to preclude the removal of water hammer, but we cannot attribute hammer to the ells alone unless we can neglect water flow.

Figure 3 shows a venting pipe (6 in.) at the junction of the horizontal pipe and the vertical pipe in the condenser water outlet line.

As I mentioned, opening or closing of this vent line had no effect on the operation of the system or on the water hammer.

We have been conjecturing on the possibility of water sealing off the vent line when the water flow is increased beyond some critical velocity. With relatively low rates of water flow, the pattern within the piping at the 14 in. x 14 in. x 14 in. tee could be as shown below:

Vapor or air bubbles at the reduced water flow can pass up through the falling water and be extracted either through the vent line or back through the horizontal pipe above the water level. These air and vapor bubbles are shown in Fig. 4.

If the vent line is closed, bubbles of vapor or air can still return to the condenser through the horizontal pipe. As the water flow is increased, it may be that the water forms a seal and prevents the entrained air and/or vapor being vented upward. This situation is illustrated in Fig. 5. Water carries air and/or vapor down to water level or below, where weight of water either flattens bubbles or they collapse due to pressure changes.

This theory has as substantiation, for what it may be worth, the fact that at reduced water flow (both at 27.5 in. Hg and at 28.4 in. Hg vacuum) the hammer is absent, but at higher flow rates at either of the two vacuums noted, the hammer is present.

There are two methods by which, we feel, this might be corrected. The first, shown in Fig. 6, would be to extend the present vent pipe, slotted as indicated, to attempt to collect and eject the vapor and/or air trapped by the potential water seal.

The extended vent pipe would not be slotted at the entrance to the tee from the horizontal pipe since the increase in water velocity due to the 16 in. x 14 in. reducer would probably be apt to force water into the slots. Incidentally, this velocity increase at the entrance to the tee is possibly another factor aiding the creation of a water seal at this point.

The second possible method would be to raise the water level in the tail-pipe by means of a restriction in the vertical pipe (an orifice or a butterfly valve) so that the entire vertical leg up to the horizontal pipe is a solid column of water. Figure 7 shows this possibility.

By establishing this solid column of water, we would avoid the creation of a vapor space above the water level and below the horizontal leg — thus force vapor and/or air out the vent pipe. We would in effect be raising the level in the pipe at which the absolute pressure is changing from negative to positive and thus induce de-aeration near a vent source not influenced by water flow.

I would appreciate the opinions and comments of your readers on the means I have indicated for removing the water hammer.

An Unusually Complete Answer to Question No. 512

# Figuring Pneumatic Sawdust Conveyors

By H. B. WAYNE

IN QUESTION NO. 512, given in the August, 1953 issue, R. J. requests information about pneumatic conveying systems since he plans to install one for handling sawdust. He states that the average dust density is 40 lb per cu ft, and that it is handled at the rate of 7 cfm or 280 lb per min. This is the maximum load for which the system should be designed, but the average load is about 80 per cent of this figure.

Questions asked by R. J. are:

1. How can I calculate the required blower capacity?
2. If steam eductors are used, will the dust be too wet to fire the boilers?
3. Will the resin in the dust cause resinous deposits in the conveying system?

The following is offered for R. J.'s guidance:

From the description of the proposed system, I have assumed that the dust will feed from a hopper into a duct or pipe on the discharge side of the blower and be transported under positive pressure to a dust receiver, the remaining mixture of dust and air then passing through a cyclone dust collector as shown in the illustration.

### Calculations for Flow and Power

The procedure to be followed in designing such a pressure system is as follows:

1. To calculate cu ft of air required per lb of dust,

$$Q = \frac{3W}{100}$$

where Q = cu ft air per lb material, and W = lb per cu ft of material being transported. (Note: W is the specific weight — not the specific gravity — of the material.)

2. To calculate required air velocity in the vertical duct, use the equation

$$V_v = 7\,\frac{(W \times L)^{\frac{1}{2}}}{C}$$

where $V_v$ = required vertical air velocity in fps, W = weight of particle in oz per cu in., L = longer axis (thickness) of dust particle in in., and C = efficiency of blast expressed as a decimal.

To calculate required air velocity in the horizontal duct, use the equation

$$V_h = 13.5\,(W)^{\frac{1}{2}}$$

where $V_h$ = required horizontal velocity in fps, and W = particle weight in oz per cu in.

A *minimum* velocity of 50 fps is recommended for both vertical and horizontal ducts, regardless of the values calculated.

3. Select the required duct or pipe size to give the required air velocity when passing the flow quantity as determined in steps 1 and 2.

4. Revise the air volume and air velocity to meet the requirements of a standard duct or pipe size.

5. Calculate the various air pressure losses as follows:

a. Pressure loss at inlet to duct from feed hopper in oz per sq in.

$$= 5\left(\frac{V^2}{10{,}000}\right)$$

where V = velocity in fps.

b. Duct or pipe line pressure loss in oz per sq in.

$$= \left(\frac{V}{100}\right) \times \left(\frac{L}{100}\right) \times P = \frac{VLP}{10{,}000}$$

where V = velocity in fps, L = pipe lengths in ft, and P = air pressure in oz per sq in.

c. Pressure loss in tank or receiver (this is taken as the average value of 4 oz per sq in.).

d. Pressure loss in duct or pipe between separator and dust collector (this is taken as the average value of 3 oz per sq in.).

6. Total air pressure loss in oz per sq in.

= (a + b + c + d), item 5

7. Calculate required hp to overcome material pressure losses as follows:

a. Pressure loss due to inertia, in hp,

$$= \frac{TV^2}{100{,}000}$$

where T = tons handled per hr, and V = air velocity in fps.

b. Pressure loss in duct or pipe, in hp,

$$= \frac{T}{1000}\left(H + \frac{L}{5}\right)$$

where T = tons handled per hr, H = lift in ft, and L = pipe length in ft.

c. Pressure loss for each 90 deg elbow, in hp,

$$= \frac{TV^2}{200{,}000}$$

where T = tons handled per hr, and V = air velocity in fps.

8. Total hp required = (a + b + c), item 7.

9. Pressure in oz per sq in. converted from hp

$$= \frac{hp \times 3200}{Q}$$

where hp = sum from item 8, and Q = air flow in cfm.

10. Total pressure loss in oz per sq in. = item 6 + item 9.

11. Total pressure loss in psi

$$= \frac{\text{item } 10}{16}$$

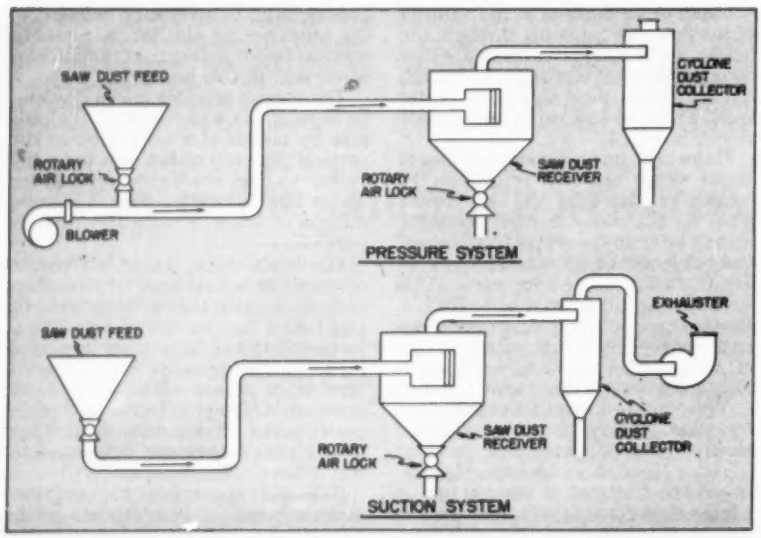
12. For a pressure system, required hp

$$= \frac{Q \times \text{item } 11}{175}$$

where Q = air flow in cfm.

13. For a suction system, required hp

$$= \text{item } 12 \times \left(\frac{14.7 + \text{item } 11}{14.7}\right)$$




Schematic diagrams of pressure and suction types pneumatic conveying systems for handling of sawdust

### Layout Suggestions

For laying out the actual system, the following general suggestions are offered:

1. Make minimum radius of bends not less than three duct or pipe diameters.
2. Provide a sufficient number of

cleanout openings in ducts or pipes for removing any material that tends to clog the lines.

3. Have any branch connections enter the side of ducts or pipes as near as possible in line with direction of flow.

4. Avoid using sudden changes in diameter of ducts or pipes, so as to lessen formation of eddy losses.

5. After calculating the required cross-sectional area of the main duct or pipe, check to see if this area is 20-25 per cent greater than the sum of the branch duct or pipe areas entering between the points in question. A value of 20–25 per cent greater is recommended to keep losses due to sudden area changes to a minimum.

### Pressure vs. Suction Systems

A pressure system is preferred over a suction system for the following reasons:

1. It is easier to maintain tight duct or pipe joints in pressure systems.

2. A pressure system allows use of higher pressure losses, permitting smaller duct or pipe sizes.

3. A pressure blower is more efficient, and therefore requires less power consumption than a suction blower.

In answer to the second question, it may be said that while the initial cost of a steam eductor and its accessories (pipe, valves, fittings, and instruments) may be less than the cost of a blower, driver and accessories, the inherent inefficiency of a steam eductor may more than offset this lower first cost in a relatively short period of operation. Its selection, therefore, should be carefully considered.

### Eductor Calculations

The efficiency of an eductor is given as:

$$E = \frac{M'aWa}{JM's\ (H_1 - H_2)S}$$

where M'aWa = adiabatic work of compression of air from air suction pressure to air discharge pressure, J = mechanical equivalent of heat (778 ft-lb per Btu), M's = mass of steam used per unit of time, $H_1$ = enthalpy of steam at nozzle supply at initial steam pressure in Btu per lb, $H_2$ = enthalpy of steam at eductor outlet in Btu per lb, and S = entropy of steam in Btu per lb.

Eductor efficiency ranges between 12 and 20 per cent, an average value being 16 per cent. Compared to an average blower efficiency of 85 per cent, it may be seen that a blower is a preferred device for handling large volumes of air as called for in this application.

Knowing the available steam pressure and temperature, R. J. can compute the required steam quantity for an eductor based on the required air quantity. Having derived the required steam flow he can determine the per cent moisture in the sawdust. Obviously high moisture content in a fuel has a detrimental effect on the performance of a boiler. R. J. may find that the furnace design will not permit firing sawdust with this high moisture content.

Presence of resin in the sawdust combined with the steam can lead to deposits on the ducts and other equipment. From the information given by R. J., I suggest use of a blower for his air handling problem to avoid trouble with deposits.

# Questions and Answers

Your fellow engineers will answer your power plant questions. You answer theirs, get paid well. Simple? Effective? Why don't you try it?

**Question No. 517**

## How Patch Underground Oil Storage Tank?

IN OUR PLANT we have a buried oil storage tank. It is an old railroad tank car tank, about 8000 gal capacity, made of riveted steel plate. At one point it has become corroded and perforated so that the oil has seeped through into the surrounding earth.

The tank is horizontal with its top about 2 ft below a concrete floor inside a building. To remove the tank and replace it with a new one would mean disrupting our production because of the tank location. Also, the oil soaked into the ground has made it unsafe to weld in the tank, even if it could be properly cleaned beforehand.

Can any of the Q & A readers suggest a way out of this mess?

Chicago, Ill. N. J.

**PLEASE**

When submitting questions or answers, be sure that your return address is given. If this is not done, we can neither publish your letter nor make proper payment.

**Answer to No. 512**

## How Figure Pneumatic Conveyor?

**Blowers Better than Eductors—Brown**

THE TWO MOST AVAILABLE sources for data on pneumatic conveying are Fan Engineering, published by Buffalo Forging, and the chapter entitled "Pneumatic Conveyors" in Wilbur G. Hudson's book, Conveyors and Related Equipment.

Fan Engineering discusses low density systems while Hudson discusses high density systems in terms of pounds of material per pound of air.

The hp per ton per hr for conveying material in a pneumatic system is in general pretty high compared to screw conveyors or a belt conveyor, so the other conveyors should be considered if power cost is a consideration. Pneumatic conveying is economical, however, in many instances where dust is a problem or where other types of conveyors would have to be manually loaded.

R. J. reports he is producing saw dust at about 18,000 lb per hr. This would take either a large blower or a sizable amount of steam. Eductors are generally used for higher vacuum than are needed for pneumatic conveying, so we doubt that it would be economical even with very low cost steam. R. J. is not likely to have difficulty with resin deposits along with duct walls since they would be cooled by the outside air.

R. J. could work out the general planning of this system from either of the two books, or any of the companies specializing in pneumatic conveying would be glad to work out the system for him.

Syracuse, N. Y. A. M. BROWN

**Answer to No. 513**

## Can He Use Air-Cooled Steam Condenser?

**Possible, But Consider Other Means, Says Eckert**

IT IS ENTIRELY true that air-cooled condensers have found some application, especially in places where water procurement is expensive. During World War II some applications were made. In these cases the condenser pressure was from 1 to 3 psig and not under vacuum. Usually heat transfer rates were from 11 to 14 Btu per sq ft per deg F per hr. Fans imparting an air velocity of about 1000 fps were employed. Condenser tubes were finned.

Theoretically, we can cool water in a condenser down to within 10 or 15 F of wet bulb. To do this, however, would call for a tremendously large condenser with a very large supply of cooling air. I am sure it would be most expensive to do this as the auxiliary power would be expensive to a prohibitive extent.

THE PRACTICAL ENGINEER AND ELECTRICIAN

It is our feeling that as long as you have an adequate supply of cooling water, a condenser can be constructed of materials that will resist the action of the contaminants to a satisfactory extent. It is further our opinion that a cooling tower can be adapted to use of contaminated water. Would suggest this problem be discussed with manufacturers of condensers and cooling towers.

In selecting power generation equipment we would like to point out some things that should be considered. Since it is mentioned that present boilers are good for 450 psi, it is likely that superheaters can be added to bring steam temperatures up to 725 to 750 F. Consequently it is likely that the turbine would be a 400 psi, 700 F machine of substantial standard type. A machine such as this will likely consume about 15,000 lb of steam at full load, maybe a little less.

If an extraction feature is considered, we would suggest that the amount of process steam needed be calculated to a fine point and an accurate process steam flow curve constructed for a day, week, month and year. If this curve shows that process steam needs are considerably over the steam needs of the turbine, i.e., 15,000 lb for turbine as against 40 to 50,000 lb for process, we would then study the possibility of a non-condensing machine. This type machine would of course need to be economical, to furnish process steam and not exhaust to atmosphere at all. This eliminates the condensing system altogether.

Another point should be raised. If process needs are this divergent as against power needs, steam engines can be applied operating at a lower pressure calling for less expensive piping, etc. Still another point is that if a single turbine is to be considered, what about standby? A single machine, if a breakdown occurs, embarrasses your capability 100 per cent. Two 500's will reduce the possibility somewhat. The same is true of engines. If, however, process needs are about 10,000 to 15,000 lb per hr we would feel that an extraction machine would be more the answer.

All in all, a good study of process flow versus power needs will necessarily have to be made before the true answer can be arrived at.

ALBERT R. ECKERT
Mt. Vernon, Illinois

**Answer to No. 515**

## How Cut FW Heater Losses?

**Don't Use Perforated Pipe, Says Kalman**

IN MY OPINION, he should not put perforated pipe into the heater to try to heat the water. First of all, the pressure is carried too high. It should be about 2½ to 3 psi continuous steam feed so that steam and water will mingle together and the heated water will drop down below the trays. O. E. does say that he has an automatic butterfly valve, but he doesn't mention where it is connected. There should be an atmosphere relief valve before the exhaust head and so set, with the long arm and adjustable weight on it, that it will open up at less then 6 psi pressure. We all know that open heaters should be open to the atmosphere so we can get rid of all the oxygen.

If Mr. E. would install a 1-in. pipe from the top of the heater to the atmosphere upright with its cap drilled with a ⅛-in. hole, this should be sufficient to get rid of the oxygen. A safety valve, as he mentioned, is on the heater; the setting on that valve should be 3 psi pressure, that is to blow off 3 psi pressure.

The atmospheric relief valve is very important in order to hold the steam in the heater long enough to heat the water. The adjustment on the arm of the relief valve should be just enough so that a little haze will come through the exhaust head. He will find out that he could heat his water 212 F or above if he does this.

If he put pipes in the heater he would have a lot of noise to listen to because when the water temperature is below 100 F, they would vibrate so that he would think the heater was falling apart. This is my personal experience.

Clifton, N. J. JOHN KALMAN

# PRACTICAL HINTS AND KINKS

**How about the gadget you made or the trick you used to do your job better? Write us about it. Send a sketch too. You will be paid well for contributions.**

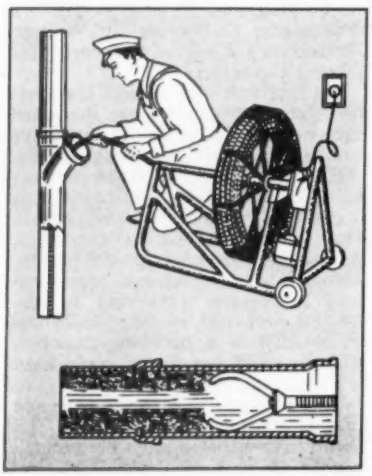
## Superheater Cleaned Under Emergency Conditions

By HENRY D. FISHER

AN ENGINEER of my acquaintance recently did a very clever job of cleaning a superheater under emergency conditions which required him to get the boiler back into service with the least possible delay.

The superheater is of the drainable type with three rows of substantially vertical drain U-tubes (2 in. od, No. 7 gage), the end radius of the bends being 3 in., 7½ in., and 12 in. in the inner, middle and outer rows respectively. Considerable amounts of sludge, principally calcium phosphate, had accumulated in some of the tube bends because of an unsuspected amount of boiler priming. This was shown by cutting apart the three or four tubes which blistered and revealed this condition.

It did not seem possible to reach this scale accumulation with a tube cleaner (even if one had been available) because of the short radius of the bends. Acid cleaning was not very promising either because of the difficulty of flushing out all gases which might be trapped in the top of the tube bends.



Sketch from a typical Roto Rooter advertisement shows cutting blades clearing root-clogged drain

The engineer's final solution was to engage the local "Roto-Rooter" operator, who broke one or two sets of cutters on some of the harder deposits but cleared the tubes in a very satisfactory manner. The boiler was then acid cleaned, the superheater being treated by forced circulation with a pump. Acid filtrations indicated that all residual scale was removed.

## Time to Coat Sweating Tanks and Lines

NOW IS THE time to apply sweat- and rust-inhibiting materials to cold water tanks and pipe lines. During the summer, such sweating is too severe to allow proper application. Now, however, the relative humidity of inside heated air is low (dew point is lower than the vessel temperature) and the coatings can be readily applied. Such coatings are commercially available and will improve life and appearance of equipment.

# Try Moving Heavy Stuff on Ball Bearings

WHEN FACED with the problem of moving heavy equipment where there is no head room to lift or the capacity of available cranes is inadequate, consider the possibilities of sliding the load on ball bearings. Improvised flat or track-type ball bearings are simple to make, and they can support tremendous loads.

E. Ingerslev of J. L. Kier & Co., Ltd., demonstrated this fact when he used this scheme to move a 1900-ton water tower 300 yards in Bedford Rural District Council area in England. The tower was 80 ft high and supported by 12 concrete columns. Demolition of the tower was considered until his estimate indicated that it could be moved and reset for about half the cost of building a new tower at the new location.

Ingerslev laid down a concrete-based rail track on which to pull a cradle bearing the tower. A D7 Caterpillar tractor furnished the power through a 10 to 1 block and tackle, which increased its 5-ton drawbar pull to 50 tons. The track consisted of continuous ball races made up of ordinary bullhead section railway lines (or rails) laid on their sides. The tracks were paired to provide two races under each side of the cradle, and between the upper and lower races were about 800 steel balls about 2½ in. in diameter.

The lower race bore on a trapezoidal concrete block 2 ft wide at the top and 6 ft wide at the bottom. The upper race bore on pre-stressed concrete beams which constituted the cradle and which were cast as integral parts of the tower's structure. (Where the beams went through the tower's structure, only holes were drilled to allow passage of cables.)

A special concrete roadway, consisting of 4 in. of concrete on a hard core base rolled into the clay subsoil, supported the trapezoidal blocks. As the tower was rolled forward, blocks from the rear were picked up and moved up ahead on the roadway.

When the roadway, cradle and track were completed and the cradle rested snugly on the track, eight of the tower's 12 supporting columns were blasted away. This left four columns supporting the tower, and these were gradually cut away to allow its weight to bear on the track.

While this moving technique saved the structure, it certainly set no records on the speedways. With the crews working continuously in fair weather and foul, the tower was over its new foundations four weeks after it was moved away from the original site.

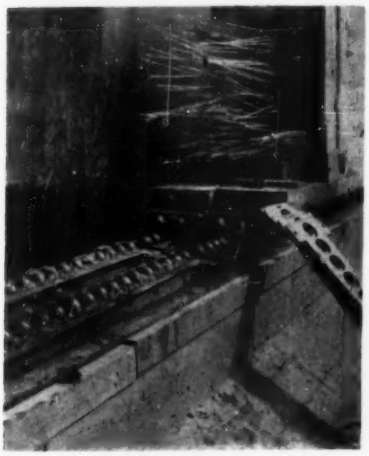


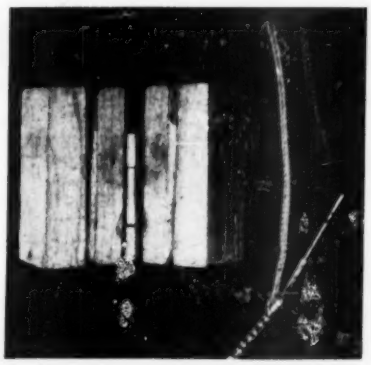
Fig. 1. Pre-stressing cables project from beam. Grease-coated steel balls sandwiched between two bullhead section rails bore the entire 1900 tons weight. Note pre-stressing cables in the cradle

Fig. 2. A Caterpillar tractor and a 1900-ton tower march royally across the English countryside—on ball bearings. Hoisting rig on tractor is for moving trapezoidal blocks of track foundation forward

# Removing Plastic Overcoat from Braided Wire Shielding

SPLITTING THE PLASTIC coating on 20-gage wire without simultaneously splitting the braided metal shielding underneath is a job that compares roughly with splitting hairs. At least, this was the case at Temco Aircraft Corp., in the days when a razor blade or knife was used. Those days are gone for Temco, however, because Assistant Foreman Carl Bownds made up a new sheath splitter.

The new splitter consists of two blocks of hardwood, each ¾ x ¾ x 2 in., which are hinged at one edge. Opened, the blocks reveal a channel into which the wire is placed. Closed, the blocks confine the wire in the channel (which was drilled through the mating faces with a No. 30 drill).



Plastic sheath (upper right) is slit and removed from braided shield with this home-made cutter

Bownds ground a tiny blade on the end of a broken No. 30 drill bit and inserted it in one block so that it protruded slightly into the wire channel. A set screw intercepts the drill bit and is used to retain the depth of cut once it is set. The blade shape is triangular and the knife edge begins the cut.

Temco now uses Bownds' device in a number of "pig-tailing" operations in which the braided shield is separated as shown in the illustration and attached to a grounded terminal on the plug adapter. They save about 1½ man-hours a day per splitter used, and it takes only an hour or two to make one.

In making splitters for wire in other sizes, Bownds recommends using the same size bit for a blade that is used to bore the channel.

# Spacing Holes on Bolt Circles

**If you are locating hole centers on a face plate and drilling them on a drill press, you can save time and money by applying this simple technique**

**By F. E. RILEY**

PIPES, VALVES and other flanged equipment items are frequently stocked without bolt holes so as to increase their applicability throughout the plant. Standard procedure followed when these holes are drilled in the flange requires that the job be set up on a surface plate, marked and punched, then moved to a drill press for the actual drilling.

Herein is described a method by which the lathe operator can locate and drill the holes on the bolt circle without removing the flange from the lathe after the facing operation. A view of the set-up is shown here in Fig. 1.

In this case, a standard ¼-in. electric portable drill is mounted on an 8-in. bench lathe carriage. The axis of the drill is horizontal so that it can be fed into the work while it is held in the lathe chuck. Manually turning the carriage handwheel feeds the drill into the work. A portable drill cradle, supplied by the manufacturer, assists in mounting the drill on the lathe.

When the bolt holes require a larger drill than is available in portable machines, the lathe can still be used to locate and center-punch the holes for drilling in a drill press. For marking, a standard square-shanked center punch is mounted in the lathe tool post and bumped into the work face on the bolt circle (which is previously scribed with a sharp-pointed tool on the lathe). It is better to drill out the hole centers with the smaller drill and re-drill the holes with a guided bit, if one is available.

### Indexing

Indexing of the holes is accomplished by positioning the lathe chuck (hence, the work piece) in front of the fixed punch point or drill. A high quality machinist's square with a built-in spirit level is used as shown in Fig. 2 to determine the various positions. The square is laid on top of each chuck jaw in turn and the lathe spindle is rotated until that jaw is level. A four-jaw chuck will allow four equally-spaced points to be located in this direct manner. *The drill point can intersect the bolt circle at any point if it is not moved during the entire operation.*

If eight holes are required, the first four are located as in the preceding paragraph. The remaining four, since they are located at 45 deg to the first four, can be positioned by placing the 45 deg face of the square against the underside of the chuck jaw and rotating it until the spirit is level (see Fig. 3).

### Multiples of 3 and 4 Holes

Hole groups in multiples of three can be laid out easily in the three-jaw chuck. The procedure for laying out three, six and twelve holes is shown in Fig. 4 by the four views of a three-jaw chuck. To locate nine equally-spaced holes, use the method illustrated at the upper right in Fig. 4 but set the square for 40 deg for use in the three-jaw chuck. (Methods for setting the square were described in POWER ENGINEERING, May, 1953, page 77.)

Holes in multiples of four can be determined by using a four-jaw chuck as shown at the upper right in Fig. 4. The angle to which the square is set will be equal the angle between the holes. For example, position the first four of twelve holes as shown in Fig. 2, the second four as shown at right in Fig. 4, and the third four by moving the square to the opposite side and setting it on the lower right hand jaw. The sequence in which the holes are drilled is indicated by the numbers.

(*Continued on page 124*)

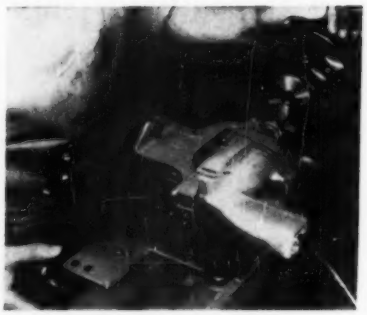


Fig. 1. Set-up of portable drill on carriage of bench lathe. Drill axis is perpendicular to work

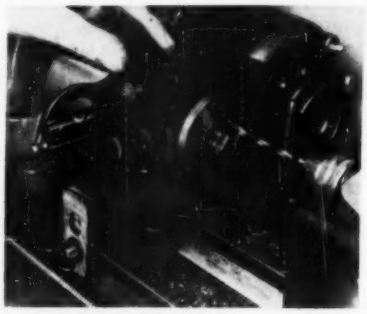


Fig. 2. Indexing the holes with spirit level in machinists' square requires true jaws in a chuck

Fig. 3. The 45° face of square against underside of jaw locates holes at 45° to first 4 when level

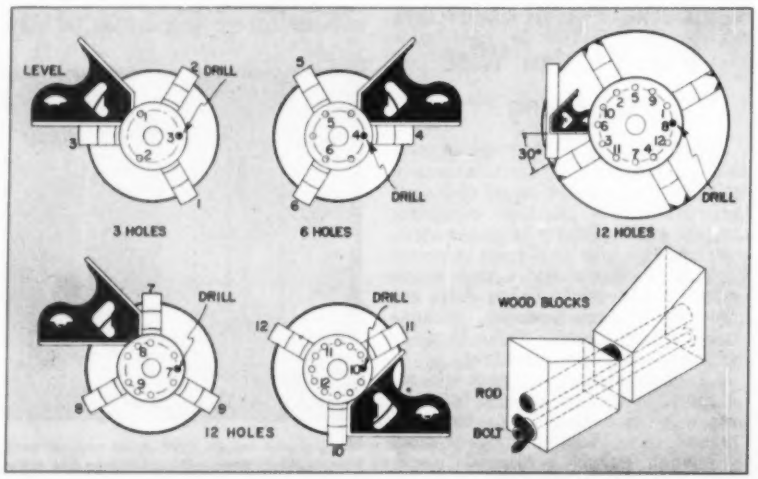
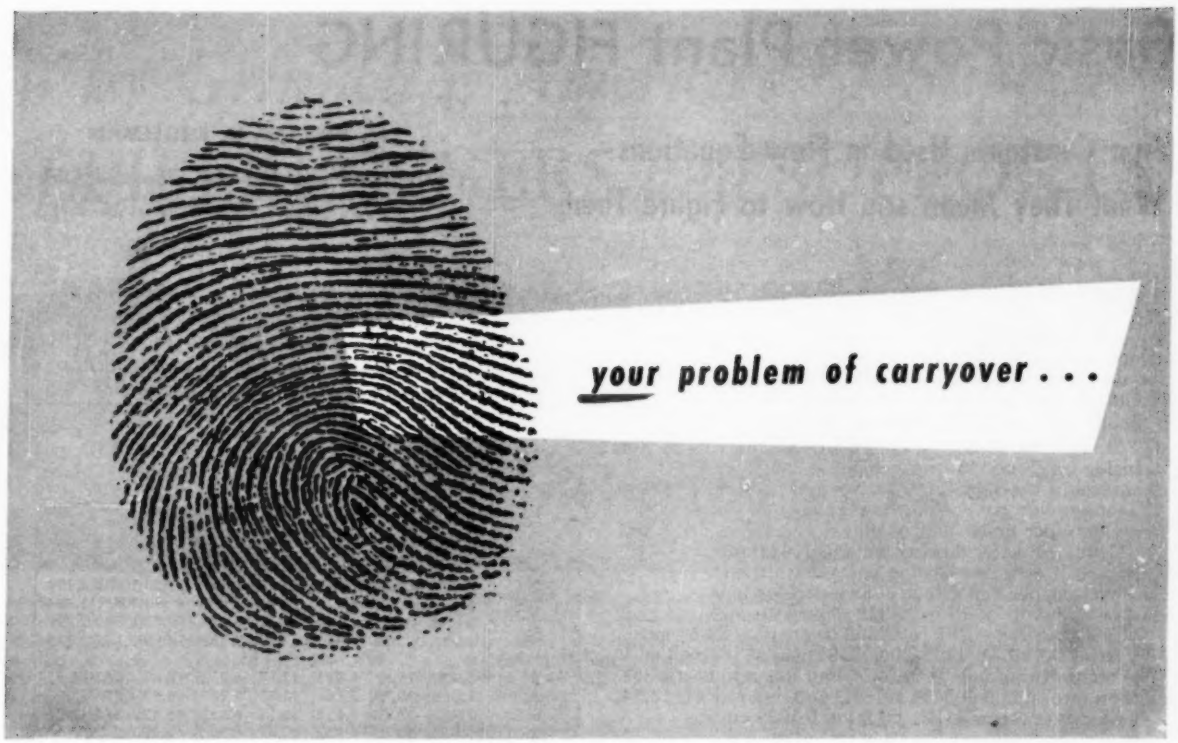



Fig. 4. (Right) Spacing holes with 3-jaw chuck is shown at left, with 4-jaw chuck at upper right. Number on chuck jaw corresponds to number of the hole being drilled when that jaw is set against square in the position shown. Lathe brake (lower right) is shown mounted on lathe in Figs. 1 & 2

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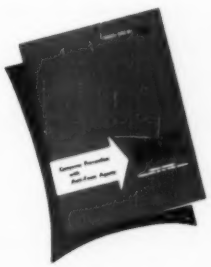

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# Basic Power Plant FIGURING

## Pipe Constants Used in Flow Equations— What They Mean and How to Figure Them

By WILLIAM H. ENGELMAN

Mechanical Engineer, Cleveland, Ohio

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MANY PIPE constants given for flow of liquid in cubic feet or gallons per minute give no information as to their derivation and the user of these formulas is always sceptical of the values. The following article should clarify this; it is a step by step solution to these constants and one should study them before applying. The following nomenclatures are used:

0.7854, a constant used for circular areas. It is 3.1416 ÷ 4.
d, inside pipe diameter in inches.
A, internal cross-sectional area in square inches, 0.7854 $d^2$.
v, average velocity of fluid flowing in pipe (fpm).
V, volume per linear foot of pipe, in cu in., cu ft, or gal.
G, the gals of water flowing per minute (gpn.).
Q, the cu ft of water flowing per minute (cfm).

The volume per linear foot of any circular pipe is:

V is 0.7854 $d^2$ × 12 is 9.4248 $d^2$ cu in.

V is 9.4248 $d^2$ ÷ 231 is 0.0408 $d^2$ or $d^2$ ÷ 24.51 gal.

V is 9.4248 $d^2$ ÷ 1728 is 0.005454 $d^2$ or $d^2$ ÷ 183.3 cu ft.

The reciprocal of 0.0408 is 24.51 and its sq root is 4.951.

The reciprocal of 0.005454 is 183.3 and its sq root is 13.54.

One gallon contains 231 cu in. or 0.1337 cu ft.

One cu ft contains 1728 cu in. or 7.4805 gal.

From the volume per linear foot, expressed in cu ft or gallons, other formulas can be derived for figuring the velocity in fpm, the discharge in cfm or gpm, and the pipe diameter. With any two values given or assumed, the third value can be calculated.

With volume desired in cfm, we have:

$$d^2 = \frac{183.3\ Q}{v};\quad d = 13.54\sqrt{\frac{A}{v}};\quad A = \frac{d^2 v}{183.3};\quad v = \frac{183.3\ Q}{d^2}$$

With the volume expressed in gpm, we have:

$$d^2 = \frac{24.51\ G}{v};\quad d = 4.951\sqrt{\frac{G}{v}};\quad G = \frac{d^2\ v}{24.51};\quad v = \frac{24.51\ G}{d^2}$$

Nominal diameter of cast iron pipe is referred to as the actual inside diameter (d) regardless of wall thickness, and is always given in even inches; thus, a 6-in. cast iron pipe has an inside diameter of 6 in.

For steel and wrought iron pipe, the *square* of the *inside* diameter is given in the table to avoid labor and reduce mistakes.

### Examples

1. A 4-in., Sched. 40 pipe, 4.026 ID, is 80 ft long and filled with water. What is the volume in: a. cu in.? b. gal? c. cu ft?

a. 9.4248 × $4.026^2$ × 80 = 12,221 cu in.
b. 12,221 ÷ 231 = 52.905 gal
c. 12,221 ÷ 1728 = 7.0723 cu ft

2. What size pipe is required to deliver 190 gpm at a velocity of 300 fpm?

G = 190 v = 300

$$d = 4.951\sqrt{\frac{190}{300}} = 4.951 \times 0.796 = 3.941 \text{ in. req'd.}$$

Use 4-in., Sched. 40 pipe. (Ans.)

3. The velocity of water is a 3-in., Sched. 40 pipe is 6 fps. What is the discharge in cubic feet and in gpm?

3-in. pipe is 3.068 in. ID, 6 fps is 360 fpm

$$Q = \frac{3.068^2 \times 360}{183.3} = 18.49 \text{ cfm} \quad \text{(Ans.)}$$

$$G = \frac{3.068^2 \times 360}{24.51} = 138.3 \text{ gpm} \quad \text{(Ans.)}$$

4. A swimming pool is 90 ft long, 50 ft wide, and, with an average depth of 6 ft, is to be filled in 6 hours. Velocity in supply pipe is 4 fps. What size pipe is required to fill the pool? Volume is 90 × 50 × 6 or 27,000 cu ft in 6 hours.

Q = 27,000 ÷ (6 × 60) = 75 cfm.

Table showing inside diameters and the squares of inside diameters of pipe.

| Nom. Pipe Size* | Schedule 40 | | Schedule 80 | | Schedule 160 | | XX Dbl. Ex. Hy. | |
|---|---|---|---|---|---|---|---|---|
| | d | $d^2$ | d | $d^2$ | d | $d^2$ | d | $d^2$ |
| ⅛ | 0.269 | 0.0724 | 0.215 | 0.0462 | | | | |
| ¼ | .364 | .1325 | .302 | .0912 | | | | |
| ⅜ | .493 | .2430 | .423 | .1789 | | | | |
| ½ | .622 | .3869 | .546 | .2981 | 0.466 | 0.2172 | 0.252 | 0.0635 |
| ¾ | .824 | .6790 | .742 | .5506 | .614 | .3770 | .434 | .1884 |
| 1 | 1.049 | 1.1004 | .957 | .9158 | .815 | .6643 | .599 | .3588 |
| 1¼ | 1.380 | 1.904 | 1.278 | 1.633 | 1.160 | 1.346 | .986 | .8028 |
| 1½ | 1.610 | 2.592 | 1.500 | 2.250 | 1.337 | 1.788 | 1.100 | 1.210 |
| 2 | 2.067 | 4.272 | 1.939 | 3.760 | 1.689 | 2.853 | 1.503 | 2.259 |
| 2½ | 2.469 | 6.096 | 2.323 | 5.396 | 2.125 | 4.516 | 1.771 | 3.136 |
| 3 | 3.068 | 9.413 | 2.900 | 8.410 | 2.624 | 6.885 | 2.300 | 5.290 |
| 4 | 4.026 | 16.209 | 3.826 | 14.638 | 3.438 | 11.820 | 3.152 | 9.935 |
| 5 | 5.407 | 25.47 | 4.813 | 23.17 | 4.313 | 18.60 | 4.063 | 16.51 |
| 6 | 6.065 | 36.78 | 5.761 | 33.19 | 5.189 | 26.93 | 4.897 | 23.98 |
| 8 | 7.981 | 63.70 | 7.625 | 58.14 | 6.813 | 46.42 | 6.875 | 47.27 |
| 10 | 10.020 | 100.40 | 9.564 | 91.47 | 8.500 | 72.25 | | |
| 12 | 11.938 | 142.52 | 11.376 | 129.21 | 10.126 | 102.54 | | |
| 14 | 13.126 | 172.29 | 12.500 | 156.25 | 11.188 | 125.17 | | |
| 16 | 15.000 | 225.00 | 14.314 | 204.89 | 12.814 | 164.20 | | |
| 18 | 16.876 | 284.80 | 16.126 | 260.05 | 14.438 | 208.46 | | |
| 20 | 18.814 | 354.00 | 17.938 | 321.77 | 16.064 | 258.05 | | |
| 24 | 22.626 | 511.94 | 21.564 | 465.00 | 19.314 | 373.00 | | |

* The nominal diameter of cast iron pipe is always referred to as the actual inside diameter (d) regardless of wall thickness. Do not use this table for cast iron pipe.

v = 4 fps or 240 fpm

$$d = 13.54\sqrt{\frac{75}{240}} = 13.54 \times 0.559 = 7.57 \text{ in. required} \quad \text{(Ans.)}$$

Use 8-in., Sched. 40 pipe; 7.981 in. ID.

5. Pipe A delivers 120,000 lb of water per hour at a temperature of 40 F. Pipe B delivers the same weight of water per hour at 350 F. Both pipes are 4-in., Sched. 80 with an ID of 3.826 in. Find the velocity in both pipes due to the difference in temperature.

Water at 40 F weighs 62.43 lb per cu ft.
120,000 ÷ 60 = 2,000 lb flowing per min.
2,000 ÷ 62.43 = 32.0 cfm

$$v = \frac{183.3 \times 32.0}{3.826^2} = \frac{5865.6}{14.638} = 400 \text{ fpm in Pipe A.} \quad \text{(Ans.)}$$

Water at 350 F weighs 55.60 lb per cu ft.
2000 ÷ 55.6 is 36.0 cfm

$$v = \frac{183.3 \times 36}{3.826^2} = \frac{6,600}{14.638} = 451 \text{ fpm in Pipe B.} \quad \text{(Ans.)}$$

NOTE: — Keenan and Keyes' Steam Table, Part I, gives the density of water for any temperature. Referring to Problem 5, we have:

Volume per lb of water at 40 F is 0.01602 cu ft.
Reciprocal of 0.01602 gives 62.43 lb per cu ft.
Volume per lb of water at 350 F is 0.01799 cu ft.
Reciprocal of 0.01799 gives 55.60 lb per cu ft.

The volume in both cases is one cu ft, but the weight per unit has decreased due to increase in temperature from 40 F to 350 F. This is very important where the weight of the liquid under consideration has to be accurate.

These formulas can also be applied to displacements of piston pumps.

*Example:* A 12 × 8 × 15-in. piston pump makes 30 strokes per minute. What is the discharge in gpm?

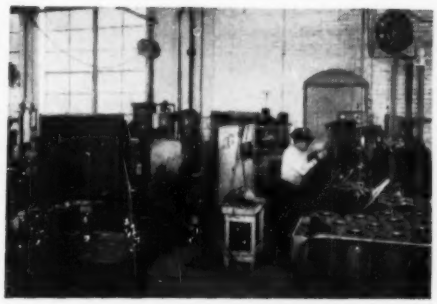
*Solution:* Velocity v is the piston travel in fpm.

v is 1.25 × 30, or 37.5 fpm

$$G = \frac{d^2 v}{24.51} = \frac{8^2 \times 37.5}{24.51} = 97.9 \text{ gpm} \quad \text{(Ans.)}$$

The calculations were carried out further than necessary for most cases in order to avoid discrepancies in the constants thus derived. In commercial practice, some decimals may be dropped without appreciable error.

# *Why Grinnell is America's #1 Supplier of* PIPE HANGERS *and* SUPPORTS



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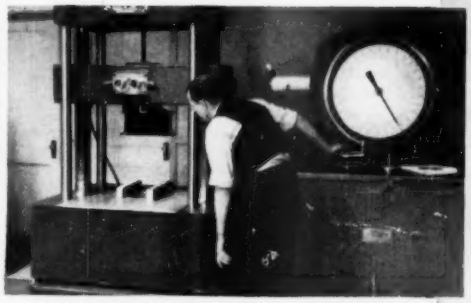

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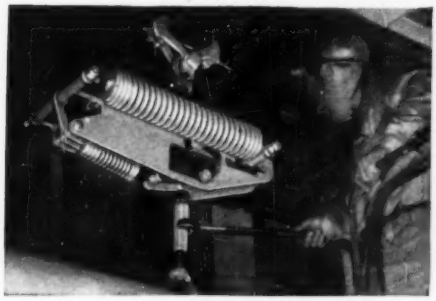

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**Once a rarity, it is now produced in quantity for atomic reactor construction. Its properties promise it a big industrial future. Here are details of the remarkable development of**

# Zirconium

ZIRCONIUM, once a rare metal, is now produced industrially by the ton. Its spectacular rise, in the last three or four years, from obscurity to an important metallurgical position, represents a phenomenal development compressed into a very short time. Stimulus for this program was the need for zirconium to clad the fissionable-fuel reactor elements for the atomic powered submarine *Nautilus*.

Peculiar properties of zirconium made it the best material for this job, but when the project was started, only a negligible quantity of zirconium was available, and it was very expensive to produce. Only five years ago zirconium cost about $250 per lb. By the spring of 1951 Westinghouse Electric Corp. was producing ultra-pure crystal bar zirconium at its Atomic Power Division in quantities measured in tons per month. The cost had come down to less than $30 per lb.

The Foote Mineral Co. was also then producing small quantities of crystal bar zirconium. The Carborundum Metals Co., Inc., is setting up to produce for the Atomic Energy Commission sponge zirconium at the rate of 150,000 lb per year for five years, and Allegheny Ludlum Steel Corp. has announced an expanded program for producing zirconium strip and other shapes for atomic energy applications. Other firms are expected to enter the metallic-zirconium field.

Zirconium is lighter than steel and has a high melting-point, remarkable corrosion resistance, is a good strong workable structural material, and — most important for its use in a nuclear reactor — it doesn't waste neutrons. Other metals, like iron, steel, aluminum, and other metals of normal strength "absorb" these neutrons and thus interfere with atomic fission, while zirconium offers no such resistance.

The problem with zirconium, since it was first discovered in 1789, has been to produce the metal in pure form, free from many impurities with which it combines in nature. Several processes were developed many years ago, but only to the point where small quantities of pure zirconium could be produced, and those at high cost. Now zirconium that is 99.9 per cent pure is being produced in quantity.

### Ample Reserves

Though absolutely pure zirconium has been hard to obtain, there has been no shortage of raw material. Zirconium bearing ores are found in large quantities in the seacoast sands of Australia, India and Brazil, and United States has ample reserves in Florida, Oregon and Idaho, according to a report published in the *Westinghouse Engineer*.

Zirconium-bearing sands go through reduction processes that produce zirconium sponge — porous chunks of metal that look like coke. This sponge, though relatively pure, still has impurities that make the metal unfit for atomic reactor work, so it has to undergo further refining processes to produce absolutely pure crystal bar zirconium. Now, however, ways to use the cheaper zirconium sponge have been discovered, and it is probable that in future the sponge will be used directly for reactor work.

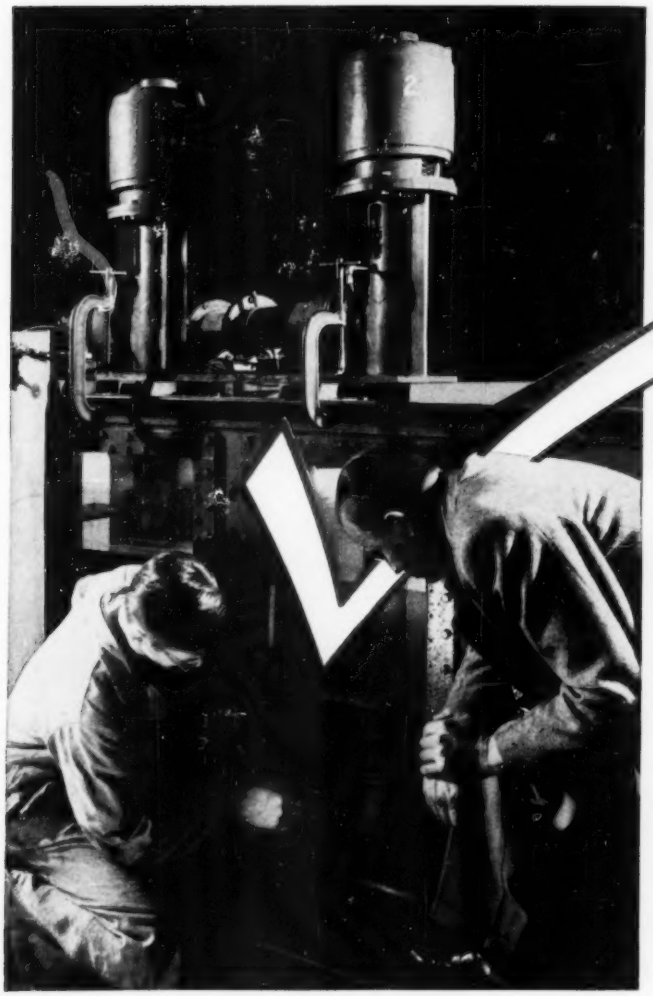
Zirconium has many interesting properties that industry can make use of when its cost comes down still further. Commercially pure zirconium resembles stainless steel in appearance. It is ductile and malleable. Its outstanding virtue is its corrosion resistance. It is not attacked by ordinary atmospheres, by hot fresh water or by salt water at ambient temperatures, nor is it attacked by alkalies. Zirconium's resistance to corrosion has long made it a favorite of surgeons for use as pins, screws, and plates for bone repairs and surgical instruments.

Up to now tantalum has been used for many industrial corrosion-resistant applications. Zirconium is more plentiful than tantalum; it is lighter, it wears better, and even now it is cheaper. It may have extensive use for tank linings, pipes, valves, immersion heaters, etc. Its indifference to hydrochloric acid at normal temperatures makes it attractive for structural parts used in the production of magnesium, pulp, paper, salt, and bleaches.

Once the atomic program's requirements have been satisfied, and plenty of zirconium is available for industry, there is little doubt that more and more uses will be found for this interesting and useful metal.

Fig. 1. Steam cleaning crystal bars of pure zirconium after their formation

Fig. 2. An ingot of 99.9 per cent zirconium being hardness tested before use



ALLIS-CHALMERS

**PUMP Laboratory**

*Check*

# Suction Bay and Pump Performance in Advance

**Use this Allis-Chalmers pump laboratory to duplicate your suction bay design and operating conditions.**

WHY CHANCE EXPENSIVE BUILDING ALTERATIONS when you can be sure of suction bay and circulating pump performance in advance. In the Allis-Chalmers pump laboratory, an exact scale model of your suction bay can be built. Then you observe the effects of different foundation arrangements . . . can check efficiencies under partial load . . . test the ultimate capacity of your design in case of expansion . . . see what happens under different water conditions. This way you can be sure that you have the right design, down to the last detail.

### Available to Power Plant Operators and Consulting Engineers

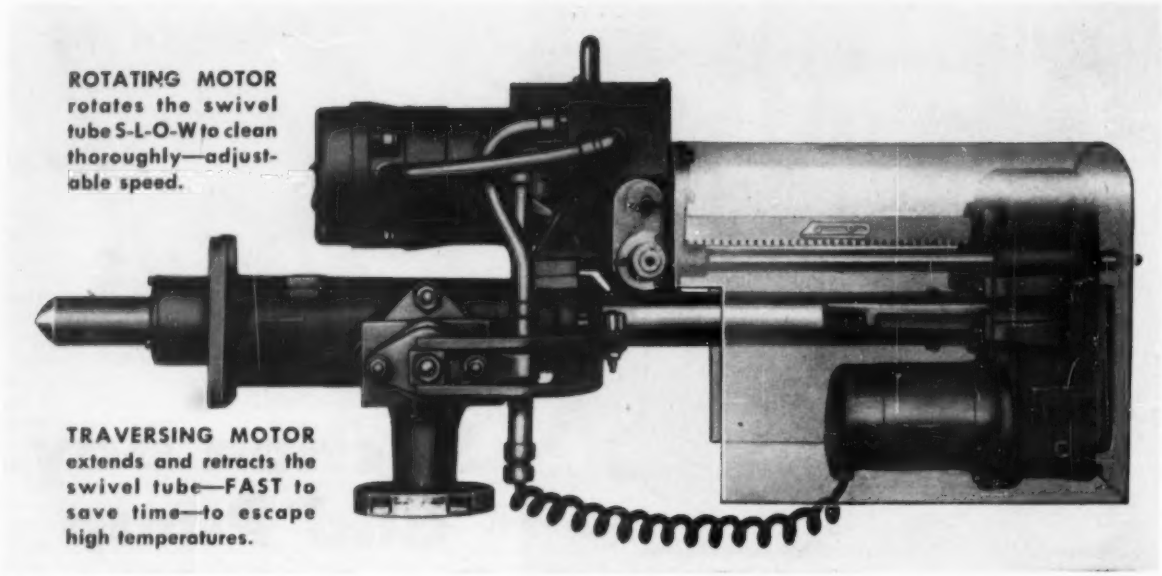
The Allis-Chalmers pump laboratory is located at the West Allis, Wisconsin, Works and is available for use for all power plant operators and consulting engineers with large pump and water supply problems. For details of the services available, call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3973

# ALLIS-CHALMERS

AC ALLIS-CHALMERS

For more data circle 550 on Post Card

# *How to* STOP SLAG BUILD-UP


ROTATING MOTOR rotates the swivel tube S-L-O-W to clean thoroughly—adjustable speed.
TRAVERSING MOTOR extends and retracts the swivel tube—FAST to save time—to escape high temperatures.

KEEP slag and sintered dust from upsetting heat-transfer capacity and superheat or reheat control. Stop their build-up—quickly and effectively—with the high-power mass blowing and fast action of Vulcan Wall Deslaggers.

Thanks to dual-motor drive—electric or air, electric shown—a Vulcan Deslagger extends into the boiler, cleans and retracts from the high-temperature zone—all in 76 seconds. The cycle can be repeated often, if needed to control deposits.

Steam, air or water—or any combination of them—may be used as the blowing medium without change in equipment. The blowing or cleaning arc can be any angle up to a full 360 degrees.

**VULCAN**
*Dual-Motor Wall Deslaggers*
With direct-acting valve
Clean BETTER and FASTER

The story is told in detail by new Bulletin 1016. Write for it.

**COPES-VULCAN DIVISION**
CONTINENTAL FOUNDRY & MACHINE COMPANY
**ERIE 4, PENNSYLVANIA**

**VULCAN** *Automatic Soot* **BLOWERS**

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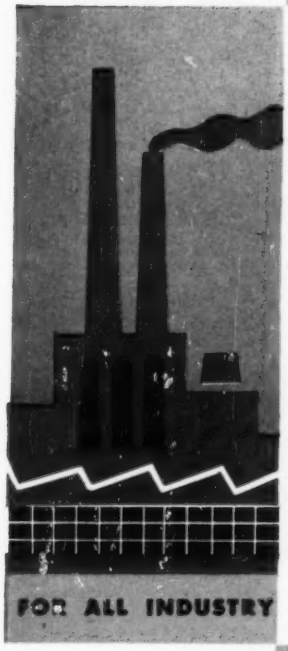
FOR 100 YEARS . . .

A NAME TO RELY ON

# WICKES

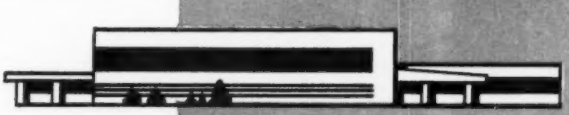


FOR ALL INDUSTRY

**RECOGNIZED QUALITY SINCE 1854**

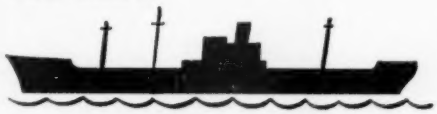
For almost a century, WICKES Steam Generators have been supplying dependable, low-cost steam to industries and institutions. Today, in every State in the Union and in foreign countries, refineries and natural gasoline plants, steel mills, foundries, ships, chemical processing plants, atomic energy installations, public utilities and many other industries depend on WICKES for efficient steam production. In schools, hospitals, public buildings and institutions, WICKES Boilers supply steam for heat and power.

WICKES can fill your requirements for all types of multiple drum boilers with capacities up to 250,000 lbs. steam per hour at pressures up to 1000 psi., adaptable to any standard method of firing. In pressures up to 900 psi. with sustcined steam production up to 40,000 lbs., WICKES Boilers can be shop assembled ready for immediate installation. For complete information, consult your nearest WICKES representative or write us today!



FOR PUBLIC BUILDINGS AND INSTITUTIONS

FOR SHIPS



# WICKES

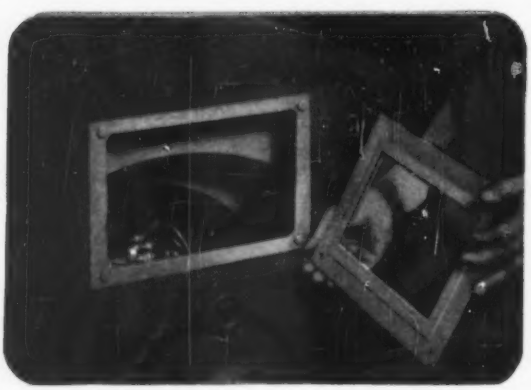
**THE WICKES BOILER CO., SAGINAW, MICHIGAN**
**DIVISION OF THE WICKES CORPORATION • RECOGNIZED QUALITY SINCE 1854**

**SALES OFFICES:** Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas • Denver Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D. C.

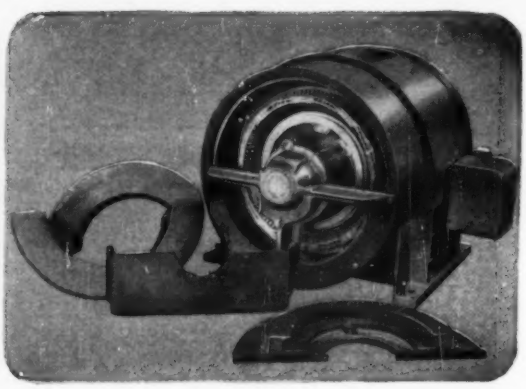
151

**For more data circle 551 on Post Card**

Below is a typical forced-ventilated installation. Motor can be arranged so ducts can be brought in at any angle.



Lucite window makes brush inspection easy. Simply remove window for quick entrance to brushes . . . for checking and inspection and maintenance.



Light, sturdy end covers and air shields are easily and quickly removed for inspection and cleaning. No crane is required. One man can do the job easily.

MORE POWER PER DOLLAR

# Synchronous Motor Offers New Installation Flexibility

When forced ventilation is required you can eliminate many installation problems with this synchronous motor. Air is supplied to the motor from both ends through air inlet brackets . . . two at each end, on either side. Duct or pipe connections can be brought from above . . . from below . . . from one side or the other . . . or a combination. Thus, you can position the motor without regard for duct work.

Covers and air shields, too, add to installation flexibility. They can be easily removed — by hand — for inspection or cleaning of the motor. No crane is required. Thus motors can be mounted in hard-to-reach places.

This added installation flexibility may open up new opportunities to save money with synchronous motors. In many cases, these motors will improve your power factor and reduce your power bill. They provide more power per dollar for many types of drives than any other motor.

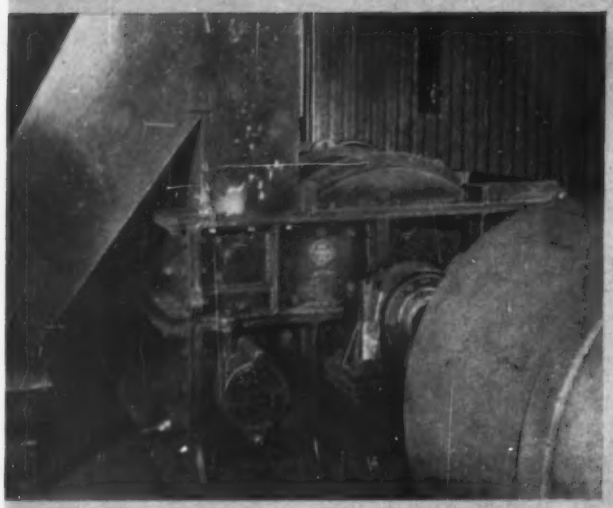
Get all the facts on Westinghouse Synchronous Motor savings. Ask your Westinghouse representative for information on the simplified inspection and servicing these motors offer. Complete information is available. Ask him for a copy of DB-3200 or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10354-A

YOU CAN BE SURE...IF IT'S Westinghouse

Matched control for the motor. This Slipsyn Synchronous Motor Control protects your motor investment . . . helps you get more for your power dollar.

For more data circle 595 on Post Card

# Check *American* Quality—Feature by Feature—and you'll know



**DESIGNED FOR REDUCING ROM LIGNITE** to ¾" product. User reports this American AC-3-C Rolling Ring Crusher reduced over 200,000 tons—without a single repair or replacement!

# WHY AMERICAN CRUSHERS can reduce coal for less than

**per ton**

## AMERICAN Feature No. 5

## EVERY *American Crusher* IS... CUSTOM-BUILT TO MATCH A NEED

Mass production, in its usual meaning, does not exist in the American Pulverizer factory. *Every crusher is custom built* to perform according to your specific needs: the type of coal, size of feed, ROM or lump, reduction to be made, percentage of fines, tonnage per hour—all are important considerations translated into the design of each American Crusher.

To build a crusher exactly suited to your needs, American has developed many different crusher types—each available in a number of sizes, and each custom-designed to give you the proper crushing elements, screen plates and grate bars to provide correctly sized reduction in the quantity desired.

Performances in hundreds of mines, power plants and central stations conclusively prove Americans will crush coal for *less than 1¢ per ton* including depreciation, replacement parts, power and interest on original investment.

*WRITE for Complete Literature.*
*Sales Representatives in Principal Cities.*

**American PULVERIZER COMPANY**

*Originators and Manufacturers of Ring Crushers and Pulverizers*

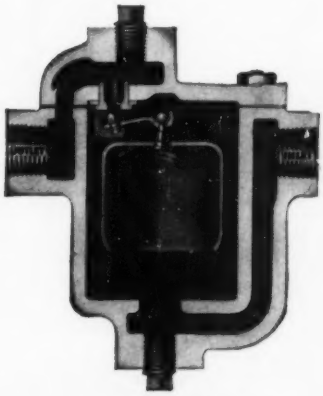
**1431 MACKLIND AVE. • SAINT LOUIS 10, MO.**

**For more data circle 511 on Post Card**

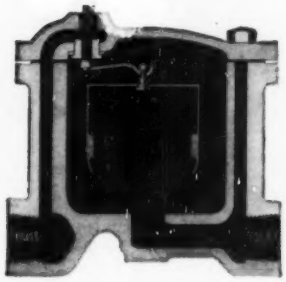
# DOUBLE DRAINAGE

## AT LOWER COST WITH

Clark DUO-STEP Leverage



CLARK 60-D TRAP



CLARK 70-D TRAP

**FAMOUS DUO-STEP LEVERAGE IS NOW AVAILABLE FOR THE FIRST TIME ON THESE SMALLER SIZED STEAM TRAPS. GET HIGHEST DRAINAGE CAPACITY AT LOWEST COST.**

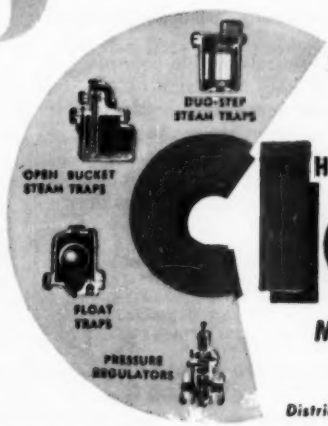
Duo-Step is the revolutionary double fulcrum principle that affords maximum leverage to "crack" the valve from the orifice seat, teamed with "Follow-through" power that opens the orifice completely. This double action actually gives you double the drainage capacity of ordinary steam traps.

**MODEL 60-D** traps are of cast semi-steel construction, designed for pressures up to 200 P. S. I. and temperatures to 400° F. Duo-Step levers and brackets of stainless steel construction. Seats and discs are of Clark-loy. ½″ or ¾″ horizontal inlet and outlet connections with ¼″ test outlet and drain plug. Vertical inlet can be furnished in ½″ or ¾″ size.

**MODEL 70-D** traps are of cast semi-steel construction, designed for pressures up to 200 P. S. I. and temperatures to 400° F. All working parts of stainless steel construction. Seats and discs are of Clark-loy Horizontal inlet and outlet connections located at bottom of trap body for close-to-the-floor installations.

**MODEL 70-TD** for pressures to 150 P. S. I. and temperatures to 375° F. is available WITH BUILT-IN THERMAL BY-PASS at additional cost.

FOR COMPLETE INFORMATION CONTACT YOUR CLARK REPRESENTATIVE OR WRITE FOR *NEW* DUO-STEP BROCHURE




HOME OF DUO-STEP LEVERAGE

# Clark

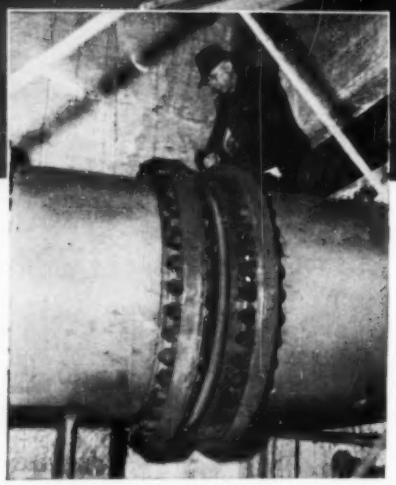
**MANUFACTURING COMPANY**

1830 EAST 38th STREET
CLEVELAND 14, OHIO

*Distributors and Representatives in all major cities*

For more data circle 590 on Inquiry Card

# 26 years under pressure... and these U. S. Rubber Expansion Joints are still full of vigor!



**The U. S. Expansion Joints** shown here (20" joint, above—48" joint, below) have been conducting cold water into an electric power plant for 26 years, yet are still in good condition.

Yes, for more than a quarter of a century these U. S. Expansion Joints have been connected to the pipe lines carrying cold river water into an electric power plant. They are still in good working condition!

*Only* United States Rubber Company can claim such service records—for "U.S." is the manufacturer who developed, produced and introduced rubber expansion joints to industry. "U.S." files are filled with long-service records like this.

U. S. Expansion Joints are economical, flexible connections used in pressure and vacuum lines to prevent excess stress due to expansion, contraction and misalignment. In pipe lines, they insulate against vibration and prevent the transmission of noise.

*You don't have to put up with pipe line troubles.* Simply call any of our 25 District Sales Offices, each staffed with engineers. Or write to address below.

U.S. RUBBER
SERVING THROUGH SCIENCE

*"U.S." Research perfects it*
*"U.S." Production builds it*
*U.S. Industry depends on it*

**UNITED STATES RUBBER COMPANY**

**MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.**

**Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Grinding Wheels • Packings • Tapes • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting**

**For more data circle 554 on Post Card**

## Level Indication

(*Continued from page 73*)

the boiler under the above conditions.

Since full accuracy of readings under operating conditions is more important than that at low pressure and temperature, it is desirable to calibrate to operating conditions, and thus introduce departure from this calibration at lower pressures. Full line curves on Fig. 4 illustrate this condition for a water pressure of 1600 psi. Similar adjustment for density may be made for any desired operating condition.

### Don't Guess at the Water Level

Efficient operation of steam boilers, particularly in the high-pressure field, requires proper correlation of the water gage readings with the actual water level in the steam drum as well as proper calibration relations with auxiliary water level indications. While the water gage is the long established reference standard, there is a growing trend, dictated largely by high pressure boiler operation experience, to relate the indicator calibration more closely to the actual water level in the steam drum. Thus, indicators are being increasingly depended upon for greater accuracy of water level indication while the gage glass is retained to insure certainty of continuous indication and control.

## Modern Fuses

(*Continued from page 76*)

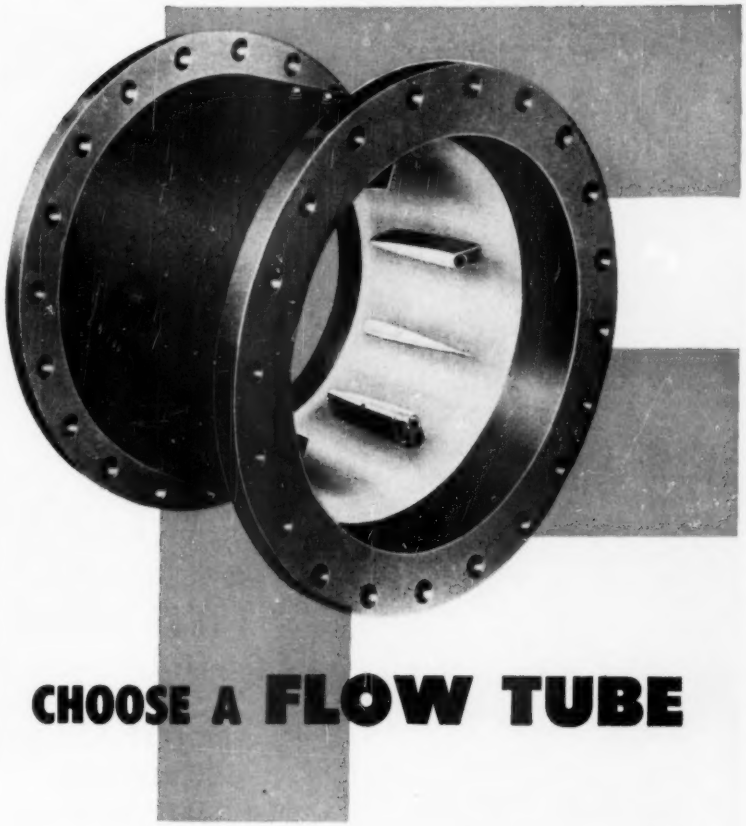
an oscillogram taken of the blow shows the actual current flowing to be much less than that available. It is for this reason that the International Electro-Technical Commission has adopted the concept of prospective current and virtual time to represent such fuse performance.

Prospective current is the current that could flow if it were not limited by the blowing of the fuse. Values of prospective current from zero to the available current can be obtained in testing of the fuse by adjusting the circuit. Virtual time is the time that the prospective current must flow to produce the same heating effect in the circuit as that produced by the current actually flowing while the fuse is blowing.

On the longer blows, prospective current is the current which is read on an ammeter in the circuit during the blow, and virtual time is the actual time required to open the circuit. At times less than 0.01 sec the prospective current is the current which would flow if the fuse were not in the circuit and the virtual time is obtained from an oscillogram made of the current flowing during the test.

In Fig. 5 are plotted the time-current characteristics of 250 v and 600 v Fusetrons, and the Hi-Cap fuses plotted using the concept of


**FOR ACCURACY IN METERING**



**CHOOSE A FLOW TUBE**

Flow Tubes are furnished with head capacity curves based on laboratory tests. For unusual piping arrangements, special tests can be run simulating actual conditions. The data furnished with each Flow Tube makes exceptional metering accuracy possible.

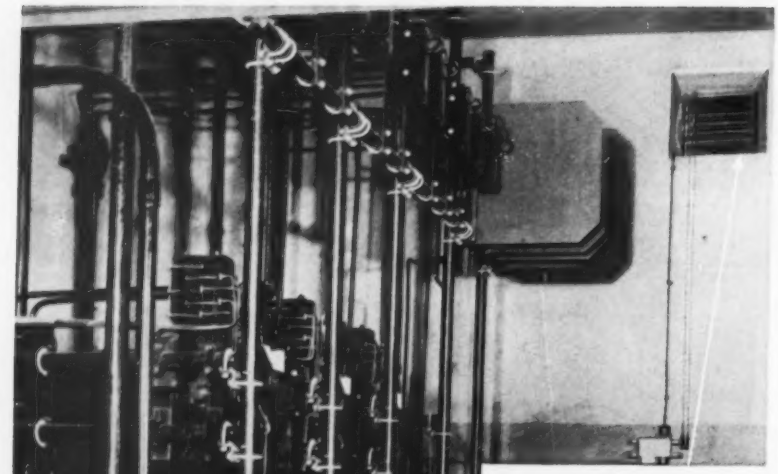
Flow Tubes have many other plus values—they're compact, comparatively light weight, and are easy to install since they require minimum straight runs entering and following. And, Flow Tubes are available in types and D/d ratios to provide differentials that can be accurately measured with the least head loss.

That's why Flow Tubes are being successfully used in scores of installations metering the flow of liquids and wet or dry gases. Available in all pipe sizes and suitable metals. They can be furnished with or without suitable secondary indicating, recording or totalizing instruments. Write for further information. For specific recommendations, send us necessary flow data.

PRESSURE REGULATORS • RELIEF AND BACK PRESSURE VALVES • CUSHION CHECK VALVES • FAN ENGINE REGULATORS • PUMP GOVERNORS • TEMPERATURE REGULATORS • FLOAT AND LEVER BALANCED VALVES • NON-RETURN VALVES • VACUUM REGULATORS OR BREAKERS • STRAINERS • SIRENS • SAFETY VALVES • FLOW TUBES

**FOSTER ENGINEERING COMPANY · UNION, N. J.**

For more data circle 555 on Post Card



*The*
WING
ELECTRIC
UNIT HEATER
is ideal for locations
like this——
PROTECTION AGAINST
DAMPNESS
AND CORROSION

Here is a familiar problem—an underground substation, unattended, where condensation is likely to occur. The simple solution of the problem is the installation of a Wing Electric Heater (shown at the upper right) which is set in operation by a dewpoint control (shown on the wall below the heater). At the first indication of excess moisture in the air, the dewpoint instrument sets the Wing Electric Heater into operation, heating and recirculating the air in the room and removing all danger of dampness and corrosion.

Wing Electric Heaters have many applications, not only in the electric utility field, but wherever heat is necessary at remote points or where steam or gas is unavailable or uneconomical.

The Wing Electric Unit Heater is made in three types—the Utility Heater shown above, the Wing Revolving Overhead, Downward Discharge Unit Heater and the Wing Electric Duct Heater Section. Sizes from 13,600 Btu/hr to 204,000 Btu/hr.

*Write for a copy of Bulletin E-1*

Wing

**L. J. Wing Mfg. Co.**

64 Vreeland Mills Road
Linden, New Jersey
*Factories: Linden, N. J. and Montreal, Can.*

**For more data circle 556 on Post Card**


prospective current and virtual time. These curves show that the Hi-Cap fuses coordinate properly with the Fusetron fuses so that in every case the smaller fuse, closest to the fault, will blow clearing the circuit without affecting the main fuse.

In addition, the extremely fast action of both types of fuses under fault conditions ensures that the induced magnetic forces will be held down to values that are harmless for a properly designed circuit.

## Engineer's License

(*Continued from page 77*)

work without ever attempting to understand the basic principles on which the tables were developed. However, some persons designated as draftsmen are, in fact, doing professional work.

Sales engineering can only be regarded as professional if it calls upon the scientific background much the same as does a design job, and must involve the designing, adaptation or modification of equipment requiring decisions based on fundamentals as in design. Much sales engineering is not professional engineering, and one whose only value lies in his selling ability or management of sales is not performing professional engineering.

In classifying the experience shown in the record, confusion exists as to what is professional and what is sub-professional experience. Military service, if involving engineering design and development, may be considered professional and is evaluated into years of accredited experience. Accounting is considered non-professional.

Design and supervision of construction of engineering works such as subways, waterworks, dams, machinery, power plants, electronic and transmission equipment, communication systems, chemical processing plants, heat transmission apparatus and aircraft (among others) are considered professional. If the experience offered by the applicant shows only routine use of procedural methods or techniques without regard to their limits or fields of application or the theory involved in their development, he offers sub-professional experience.

### In Responsible Charge

"In responsible charge" includes that of work or men. Work assigned by a superior but not requiring his direct supervision may be classified as "in responsible charge" appearing in the application. A subordinate or sub-professional in this particular sense would require continuous and close supervision in all phases of the work. The applicant who is able to work under his own "steam" definitely qualifies.

The boards do not license the specialist. They license the engineer.

# GULFCREST is the **right** oil for every steam turbine

Westinghouse 95,000 KW turbine generator recently installed at the Elrama generating station of the Duquesne Light Company near Pittsburgh, Pa. The turbine lubricating system was flushed with Gulf Turbine Flushing Oil, then filled with Gulfcrest—the worlds' finest turbine oil. This prominent utility selected Gulfcrest Oil on the basis of previous successful experience.

## the **right** base stock, Alchlor processed
## the **right** combination and concentration of additives
## the **right** background of performance

Gulfcrest Oil has a background of successful performance in every type and make of steam turbo-generator.

In many of these installations the original charge of Gulfcrest has been in service more than 10 years with no significant change in its original characteristics, and with neutralization numbers always remarkably low and safe.

To get this kind of lubrication for your turbine, call in a Gulf Sales Engineer and ask him to recommend the proper grade of this superior oil. Write, wire, or phone your nearest Gulf office today.

**Gulf Oil Corporation**
**Gulf Refining Company**
**Pittsburgh 30, Pa.**

GULF SERVES INDUSTRY

**For more data circle 557 on Post Card**

# HALL INDUSTRIAL WATER REPORT

*Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.*

Volume 1 | DECEMBER 1953 | Number 6


## Zeolite Double Trouble Solved

A utility plant has solved a bothersome two-way problem with their base exchange water softeners. Suspended matter periodically fouled up the beds so that even after regeneration the exchangers functioned at low efficiency. In addition, tanks were corroded by the brine solution used for regeneration.

These problems were presented to the Hall field engineer in the area, and were licked when he prescribed Banox.* Both difficulties were taken care of by Banox, since it has an inhibiting action on brine corrosion, and its high activity as a dispersing agent assured clean beds each time the units were regenerated.

Other problems involving "dirty" exchangers can be solved once the facts are ascertained. Different solutions may be required, for example sterilization of the bed in a case of slime accumulation.

## Paper Presented at Water Conference

B. Q. Welder, Hall engineer, presented a paper on "Gadgets" at the final session of the Fourteenth Annual Water Conference of the Engineers Society of Western Pennsylvania held in Pittsburgh on October 19, 20, 21. Co-authored by Dr. E. P. Partridge, Director of Hall Laboratories, the paper reports field observation of the performance of various devices claimed to be effective in treating water by non-chemical means. Reprints of the paper will be available after the "Proceedings of the Fourteenth Annual Water Conference" has been published.

*Banox is a registered trademark.

# Stream Polution Survey Cuts Waste Disposal Costs

In order to comply with state standards, a metal-plating plant in the midwest was contemplating the construction of a waste water installation with a capacity of 1,500,000 gpd.

A detailed study of the processes employed in the plant, conducted by Hall engineers in close co-operation with plant personnel, resulted in recommendations leading to a drastic reduction in the amount of waste requiring treatment. The practical outcome—a waste water treatment plant is being built with a capacity of only 250,000 gpd, now adequate for all requirements. Additional benefits are being realized through more efficient operation and the recovery and reuse of plating materials.

The solution of the problem of waste water disposal began with a study of process water use and the development of methods for its conservation and reuse. Since this plant had time to act before the state authorities put the pressure on, a complete study was made to supply an economical and effective result.

## Technical Information Program Covers 20 Years

Keeping clients informed is one of the continuing services of Hall Laboratories. During the past twenty years, reprints of nearly one hundred technical articles, papers and discussions have been sent to Hall clients all over the world. These reprints covered the latest developments in water treatment and allied fields, and ranged in subject matter from "Gaging and Sampling Water-Borne Industrial Wastes" to "Concentrating Films: Their Role in Boiler Scale and Corrosion Problems."

Some papers have been of such general interest that requests have come from many plants, not clients of Hall Laboratories, both in this country and abroad. For example requests for the paper on "Concentrating Films" have come from Canada, Venezuela, Argentina, England, Holland, India, Formosa, and the Philippines.

## *Industrial Water Problems Require Special Handling*

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

*Water is your industry's most important raw material. Don't waste it.*

## ASME Meeting in New York

Among papers to be presented at the 74th annual meeting of the ASME in New York are several sponsored by the Joint Research Committee on Boiler Feedwater Studies. Included is the paper, "Action of Boiler Water on Steel—Attack by Bonded Oxygen" by Kaufman, Trautman and Schnarrenberger of Hall Laboratories. Other papers cover corrosion by dissolved oxygen and the breakdown of amines in boiler water

Therefore, the specialist does not automatically fulfill the requirements for licensure in most states.

Unfortunately, there are still many older men educated as engineers who do not realize that engineering today is not what it was 30 years ago. These men are, therefore, unable to distinguish between true engineering and technical abilities. The college graduate who starts out on the drafting board must show how he has progressed through various stages to the point where he is independently applying basic engineering principles in his work.

## Oil in Feedwater

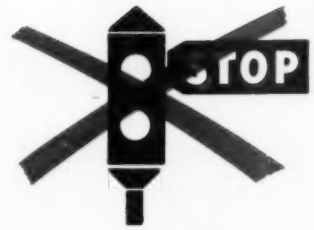
*(Continued from page 79)*

ture control in the region of the weighing apparatus, and skilled handling. The tyndalmeter, however, will indicate the presence of oil in these minute concentrations and lend itself to calibration, provided, as we have seen, that there is little or no free oil or other impurities in suspension.

It is difficult, however, to get a representative sample of feedwater or boiler water. Any permanent tube projecting into the feed line for taking samples may become contaminated with oil, and the choice of sampling position deserves careful consideration. It should be remembered that all the oil present in boiler water may not be in suspension, some of it being absorbed by solid impurities in the water and adhering to metal surfaces.

For proper control of de-oiling equipment, the power engineer needs some simple way to measure the oil content of boiler feedwater as it enters and leaves the de-oiler. Two rough and ready methods frequently used in the boiler house to detect the presence of oil have already been described, with their serious limitations. Where filters are employed, the safest procedure has been to clean the filter regularly and blow-down frequently. Frequency of filter cleaning is usually based on the filter back-pressure. The tyndalmeter is a step towards the simple means of measurement required, and the principle lends itself to the use of photo-cells for automatic control.

Extremely simple and useful application of the tyndalmeter principle is now being made in many uniflow engine plants. The feedwater sample is placed in a clean glass beaker, which is then mounted above a bright light enclosed in a case as shown in Fig. 3. A pin-hole in the shelf supporting the beaker allows the light to pass up through the water. If there is any emulsified oil in suspension, a beam of light will be apparent to an observer looking through an observation hole in the side of the case. The intensity of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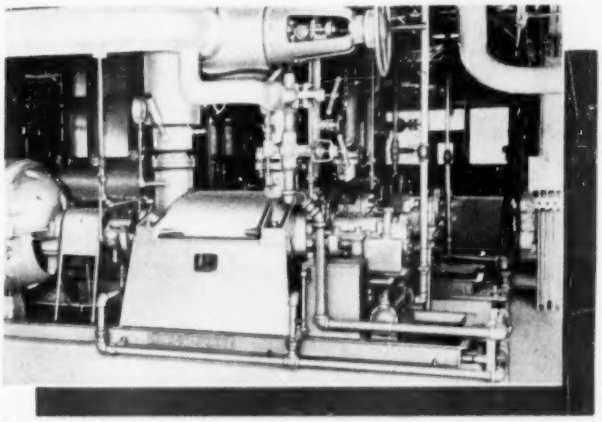

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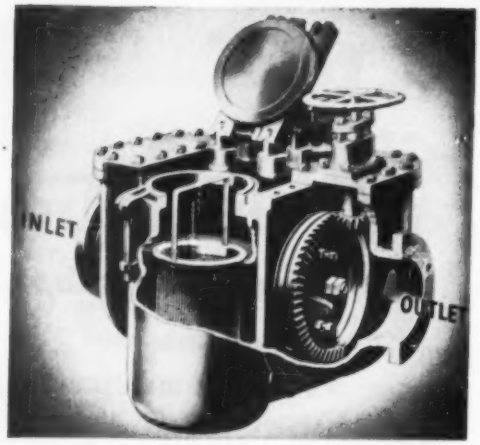
# R-S Duplex Strainer

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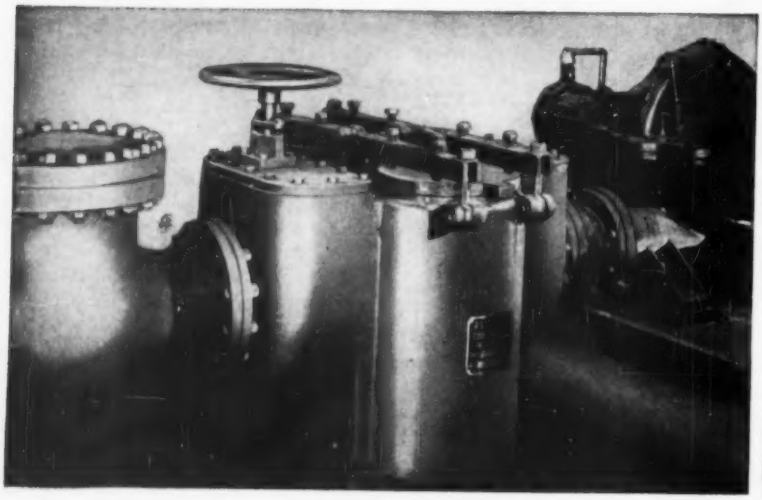

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this beam is a rough measure of the concentration of the emulsion.

It is claimed that a concentration as dilute as 0.01 ppm will produce a visible beam and that the operator soon develops sufficient judgment to estimate the degree of contamination at a glance. As with the tyndalmeter, however, the presence of solid impurities or free oil will impair the utility of this device.

### Oil Fluorescence

An instrument designed at the Royal Technical College, Glasgow, Scotland, for the British Shipbuilding Research Association, and in the development of which the writer was actively engaged, utilized the characteristic fluorescence of oil in ultra-violet light for estimating the total oil content of oily-water samples. This instrument overcame the limitations of the tyndalmeter, and though it was a little more difficult to use, because the samples had to be specially prepared, it showed great promise.

The need for a simple means suitable for use in the boiler house for assessing the total oil concentration in boiler or boiler feedwater still remains. Requirements of such a means are very exacting: It must be robust, should not require special skill for its operation, nor should it require the use of volatile or flammable solvents.

---

## $SO_2$ and $SO_3$

*(Continued from page 87)*

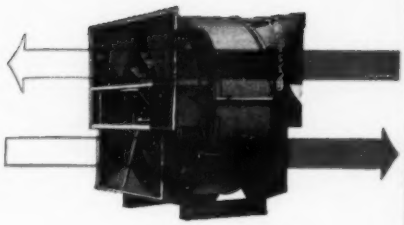
dimeter and the microammeter scale is set at its highest reading so as to give a reference which compensates for initial turbidity before the addition of the $BaCl_2$ solution.

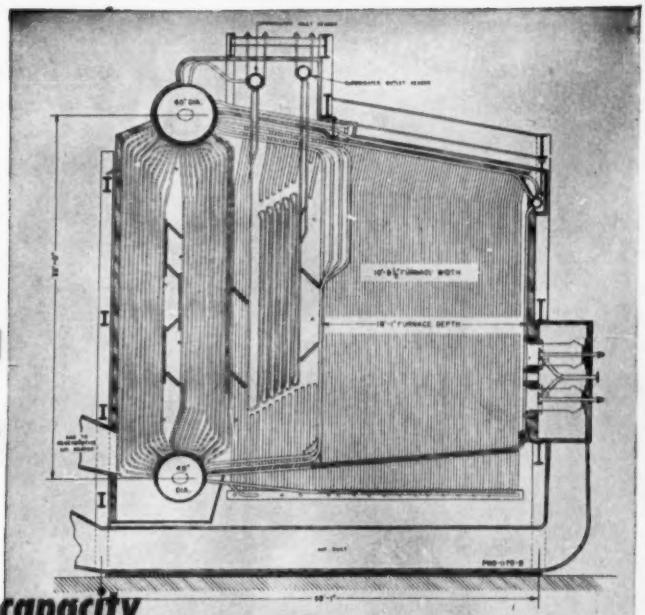
Remove the "blank" sample from the turbidimeter and replace with the true sample when it has stood the full five minutes. Record the microammeter indication. This value is entered on a calibration curve constructed by running the preceding test on samples containing known quantities of N/10 $H_2SO_4$. *When making these standards, always subtract the amount of $H_2SO_4$ added from the amount of water added.*

### Total Sulphur Determination

To determine total sulphur, place 5 ml of sample No. 1 and 5 ml of sample No. 2 in a 50-ml Nessler tube. Add 32 ml of pure isopropyl alcohol and 3 ml of distilled water to produce a 45-ml sample, and then repeat the entire procedure used in determining $SO_3$.

A separate blank sample using 1 ml of distilled water in place of 1 ml of 20 per cent $BaCl_2$ solution should be made for setting the microammeter. Since, in the total sulphur determination, the solution to be read in the turbidimeter has been adjusted to contain the same amounts





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Because it takes roughly 10 kwh of electricity to produce one pound of aluminum, the electrical generating capacity at this large new plant must be enormous. Therefore, when the plant is completed, it will have a total capacity of nearly 500,000 kw, of which 375,000 kw will be steam-generated.

The plant's vast steam requirements are met by fifteen Foster Wheeler steam generators, each with a maximum continuous capacity of 225,000 lb of steam per hr at 900 psi and 905 F. Each boiler incorporates a Ljungstrom Air Preheater, which cools exit gas to 320 F, and preheats incoming combustion air to 540 F.

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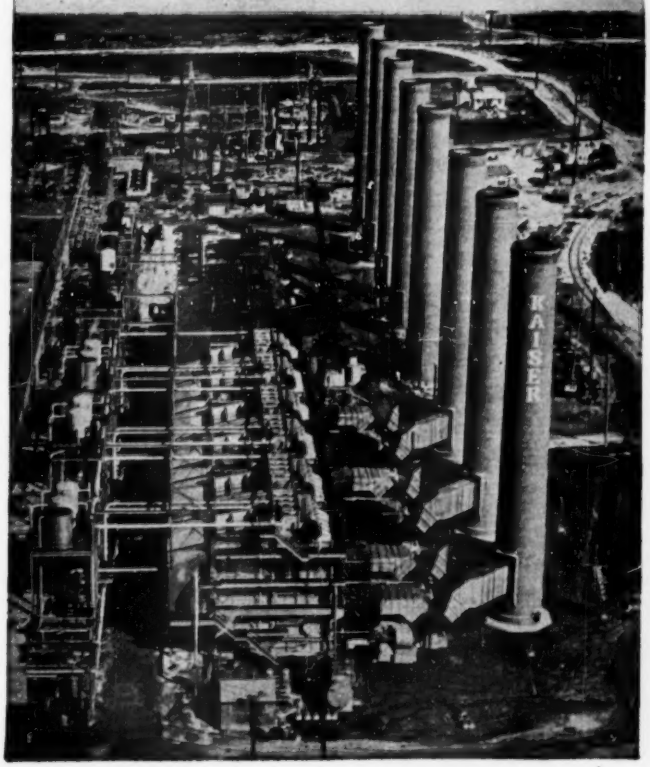


**THE Air Preheater Corporation** 60 East 42nd St., New York 17, N. Y.

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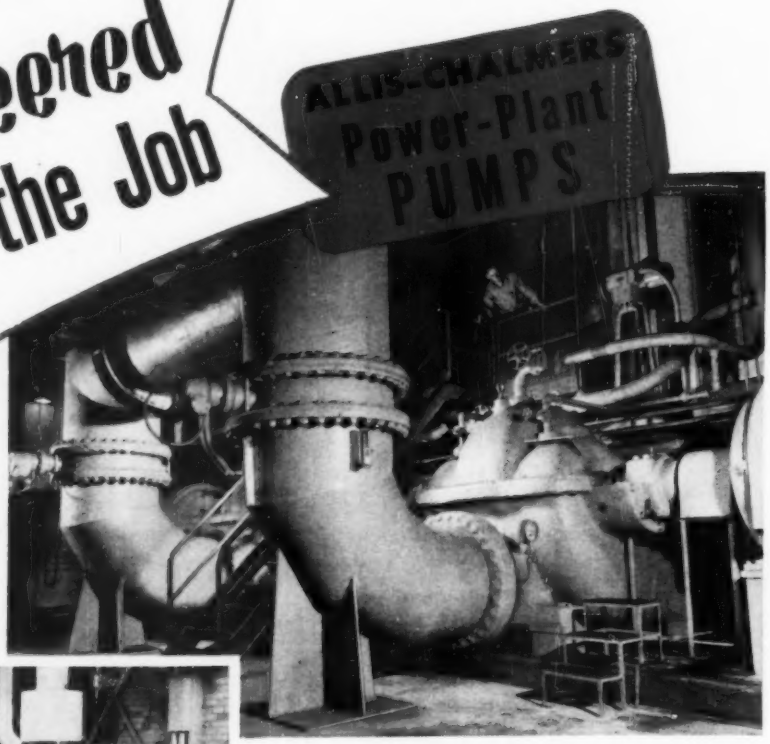
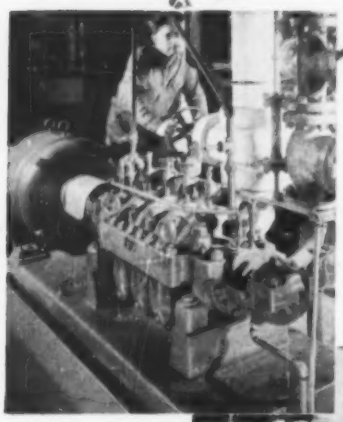
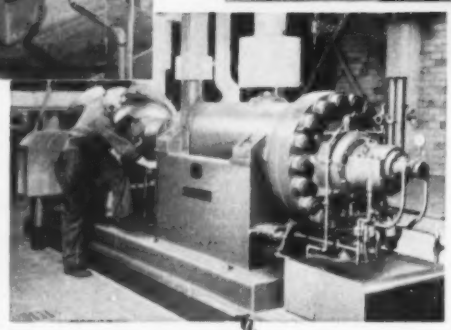
# Engineered to Fit the Job

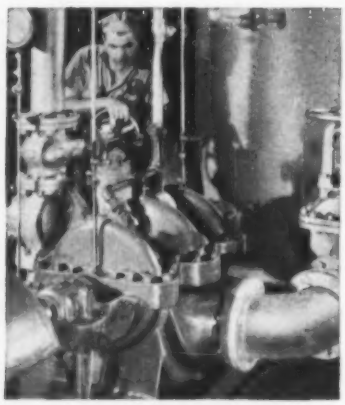



These double-suction centrifugal circulating water pumps are rated 35,000 gpm, 20-ft head. A-C also builds vertical axial and mixed flow types — providing a broad line that covers all installation requirements.





For boiler-feed service, Type M pumps provide heads up to 1200 psig. Barrel-type pumps offer high efficiencies in the pressure range of 1200 to 3000 psig, in ratings from 300 to 2500 gpm. Units shown are (above) 175 gpm, 1325-ft head and (right) 480 gpm, 4271-ft head.



Condensate pumps are designed and built for operating under vacuum and handling liquid at or near its boiling point. They are available in single and multi-stage types for vertical and horizontal mounting.

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# ALLIS-CHALMERS

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of isopropyl alcohol, HCl, water, and $BaCl_2$ as the solution containing the $SO_3$, the same calibration curve used in $SO_2$ determination can be used to read total sulphur. The small amount of peroxide present was found to have no appreciable effect on the results.

### Calculations and Results

Quantities obtained in the preceding operations are put into final form as follows:

1. Total grams $SO_3$ in total gas sample
   = determined wt $SO_3 \times 5.56$
2. Total sulphur as $SO_3$ in total gas sample
   = determined wt sulphur $\times 50$
3. Total $SO_2$ in total gas sample
   = (item 2 − item 1) $\times 0.8$
4. Percentage by volume of $SO_2$ and $SO_3$ can be calculated from the weights just determined and the volume of the total gas sample.

Comparisons made between calculated sulphur content and the content as determined by this method have shown only small discrepancies. Since calculated content itself is not guaranteed to be correct (being dependent on analytical result, also), it is possible that the turbidimeter is even more accurate than the small discrepancies indicate. The complete paper contains a table showing results of analyses made in three specific power stations.

---

## Soot Blowers

(*Continued from page 92*)

Here are the main points to check when making internal inspections.

1. Make an internal inspection of each soot blower each time the boiler is out of service. Do this as soon as possible to permit immediate corrections and thus avoid upsetting scheduled service date for the boilers.

2. Check nozzles for proper alignment with tube lanes as the unit is rotated. Make sure they do not direct their jets against tube surfaces. While it is advisable to follow the manufacturer's instructions, these check points apply generally:

A. Has the element shifted axially in the bearing or supports. If so, there is usually some slight outside adjustment on the outside support. If not, it may be necessary to cut and re-thread the element to bring nozzles into proper alignment.

B. Are the boiler tubes in proper position? A misaligned boiler tube is in danger of being cut by a nozzle which may be in line with it. If so, the nozzle must be welded shut to decrease the possibility of tube cutting.

C. Has the element "shrunk" or "grown"? (Nozzles in alignment at one end of the element, but out of alignment at the other end, as shown in Fig. 2.) This can be alleviated

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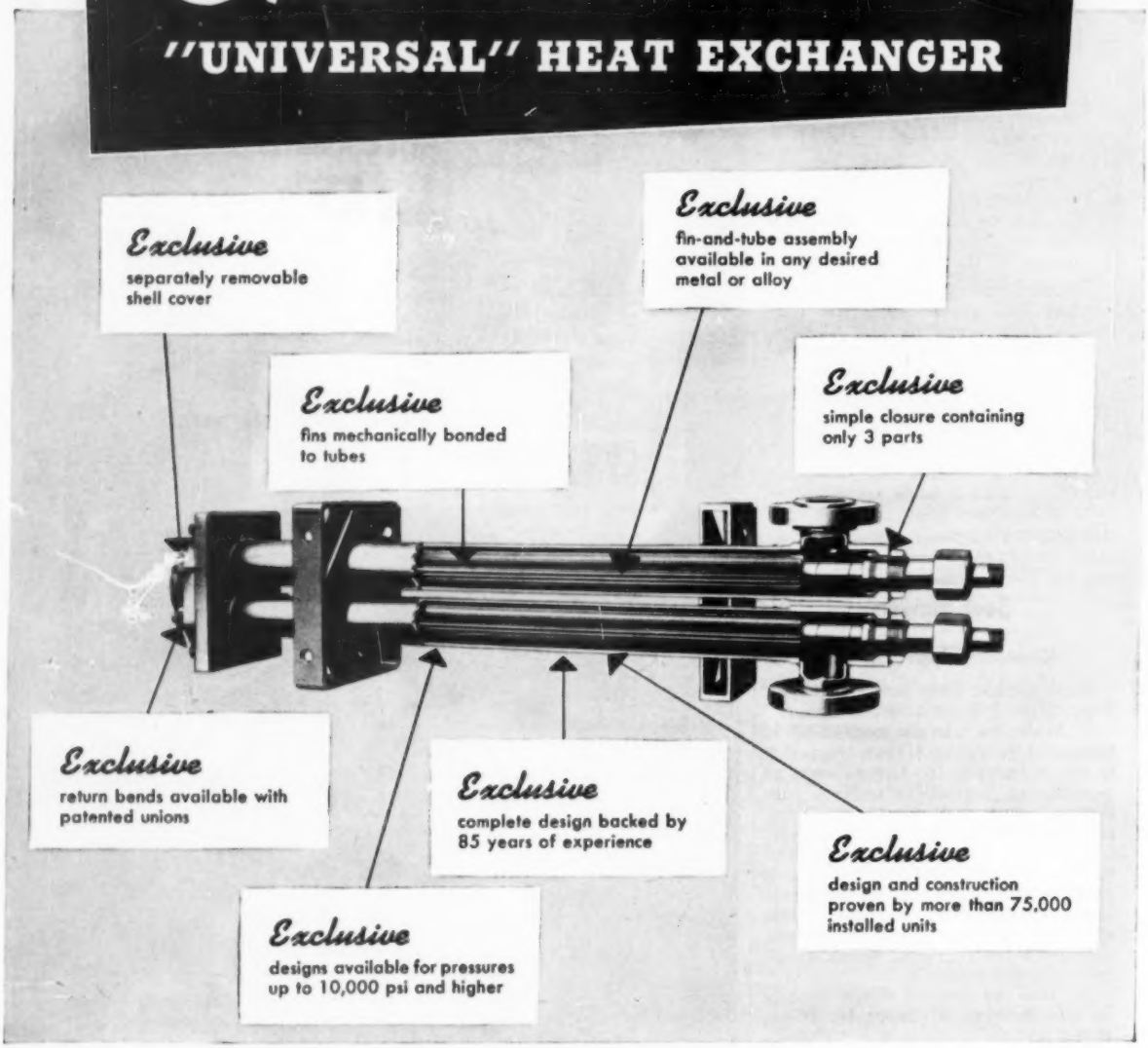
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when selecting a new element of proper type. Some elements "shrink" or "grow" more than others. Your sales or service man can help you select one with low creep characteristics.

3. Check to make sure the blowing arcs, or sweeps, are properly set. If drawings showing this arrangement are not available when the inspection is made, the manufacturer will gladly furnish them. Good judgment can usually determine the areas the unit is expected to clean, and this can be confirmed later when drawings are received. Incorrect blowing arcs are prime factors in loss of baffles, cutting of drums and, in some cases, tube erosion. Different manufacturers use different methods of establishing the blowing arc. Their service and maintenance manual should be consulted for the correct adjusting procedure.

One general statement can be made about the setting of all blowing arcs. The nozzles should be pointed along the tubes or in the tube lanes along the axis of the elements at the starting point of the blowing arc. Pressures are highest, and condensate or moisture content greatest, when the unit is first opened. Dissipating this high pressure and moisture content into the tube lane, rather than perpendicular to the tube bank, as shown in Fig. 4, minimizes tube erosion possibilities. Wherever possible, the nozzles should be pointed down to prevent fly ash from falling into them, which would create a sandblast effect when the unit was operated.

4. Check the nozzles to be sure they are in place and in proper repair. Nozzles may become enlarged or elongated from steam erosion. After long periods of time they may erode completely, so that complete element replacement is necessary.

5. Check the elements to see that they are straight, and inspect them for cracks, splits, missing nozzles or abnormal wear. Most warped or bent elements can be straightened. Manufacturers' service manuals give the best procedures, but these general rules apply:

A. Heat all elements before trying to straighten them. Heat plain steel elements to about 1400 F, processed or plated elements to about 1500 F, and alloy elements for high-temperature use to about 1650 F.

B. Use extreme care in straightening alloy elements. After exposure to boiler temperatures and cooling, they tend to fracture easily if dropped or struck too sharply by another object. Best, and perhaps fastest, method is to heat the element at the bend, then apply leverage pressure (such as an arbor press).

6. Check the bearings of the elements to be sure they are in proper alignment, tight and in good condition.

7. Make sure the proper element is installed in each location, as required by the temperatures in the zone where it will operate.

8. Observe, record and report any tube cutting or polishing that appears.


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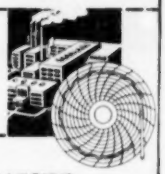

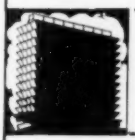

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Even the slightest erosion should be on permanent record for future reference, and so that correction of these conditions can be submitted to boiler inspectors on request.

9. Blowing pressures may be increased or decreased as required. In no case should more pressure be used than needed to clean the boiler adequately. This avoids excessive use of steam or air, and aids economy.

### Retractable Soot Blowers

**Internal Inspection**

1. Check to make sure nozzles are not worn, cracked or split.

2. Thoroughly examine all tubes cleaned to determine if there are any grooves or flat spots indicating erosion or polishing.

3. On wall blowers, extend the unit and set the nozzles at the proper distance from the surfaces to be cleaned, as recommended by the manufacturer.

4. Straighten any damaged lances by pressure, without heating.

5. Make sure lances clear all boiler tubes in their paths, including wall tubes where units enter boiler.

6. Particularly where gun blowers are used to clean slag screens, walls, boiler roofs or floors, make sure all blowing arcs are set properly.

7. Care, adjustment and maintenance of automatic or automatic-sequential soot blower system controls is generally handled by instrument or electrical departments. These control systems are reliable and require little maintenance other than that normally expected for any electric or air control system.

---

## Spacing Holes

(*Continued from page 100*)

Obviously, the lathe spindle must not turn while the holes are being drilled. Gear head lathes usually have a built-in brake to fix the spindle, but belt-driven lathes will require external braking. A simple form of belt lathe brake is shown at the lower right in Fig. 4. Two hardwood blocks, drilled for a ½-in. slide rod and a tightening bolt, are mounted under the chuck body on the lathe bed. The locking effect is gained by drawing the two blocks together to force their inclined upper surfaces against the chuck body. The brake can be seen in Fig. 1 and Fig. 2.

Before this technique is applied to the drilling and/or locating of holes, it would be wise to check the spacing of chuck jaws for accuracy. The simplest way to do this is to measure the chord between adjacent jaw slots with a vernier calliper. The chuck shown in Figs. 1, 2, and 3 has less than 0.002-in. chord variation between pairs of jaw slots. There is no need to check the lathe for level mounting, since the technique allows for off-level setting of the lathe.

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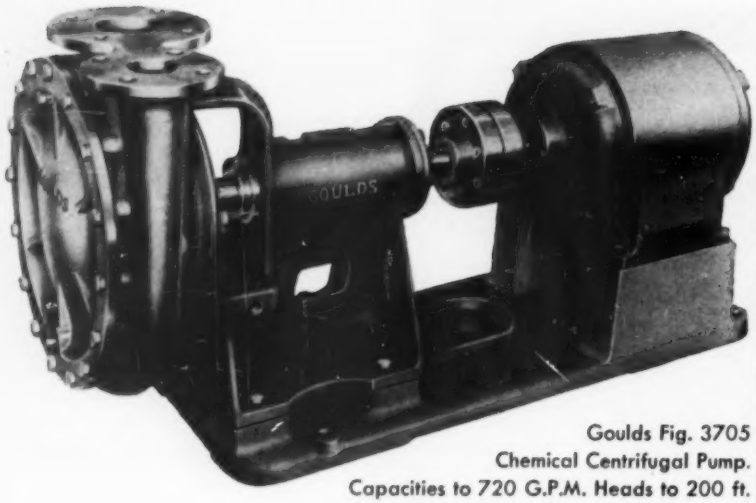


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4. All iron
5. All bronze
6. Bronze fitted
7. All iron, stainless steel trim
8. All bronze, stainless steel trim

***And you can take advantage of these four saving benefits:***

a. Long packing life and freedom from leakage—Stuffing box on suction side of impeller means pressure is limited to suction head.

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d. Low parts inventory — Interchangeable parts permit you to keep inventories down and prevent excessive down-time.

To get full information on these new materials, plus performance curves, specifications and dimensions, contact your nearby Goulds representative, or clip and mail the coupon for new Bulletin 725.3.

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## Chain Drives

*(Continued from page 69)*

chain is used for higher speed operations since its lower frictional coefficient enables it to function without generating excessive heat.

### Conditions Affecting Lubrication

Lubricants for chain drives must be selected according to the service conditions and the type of housing. The service conditions include speed, load, clearances and amount of bending or articulation.

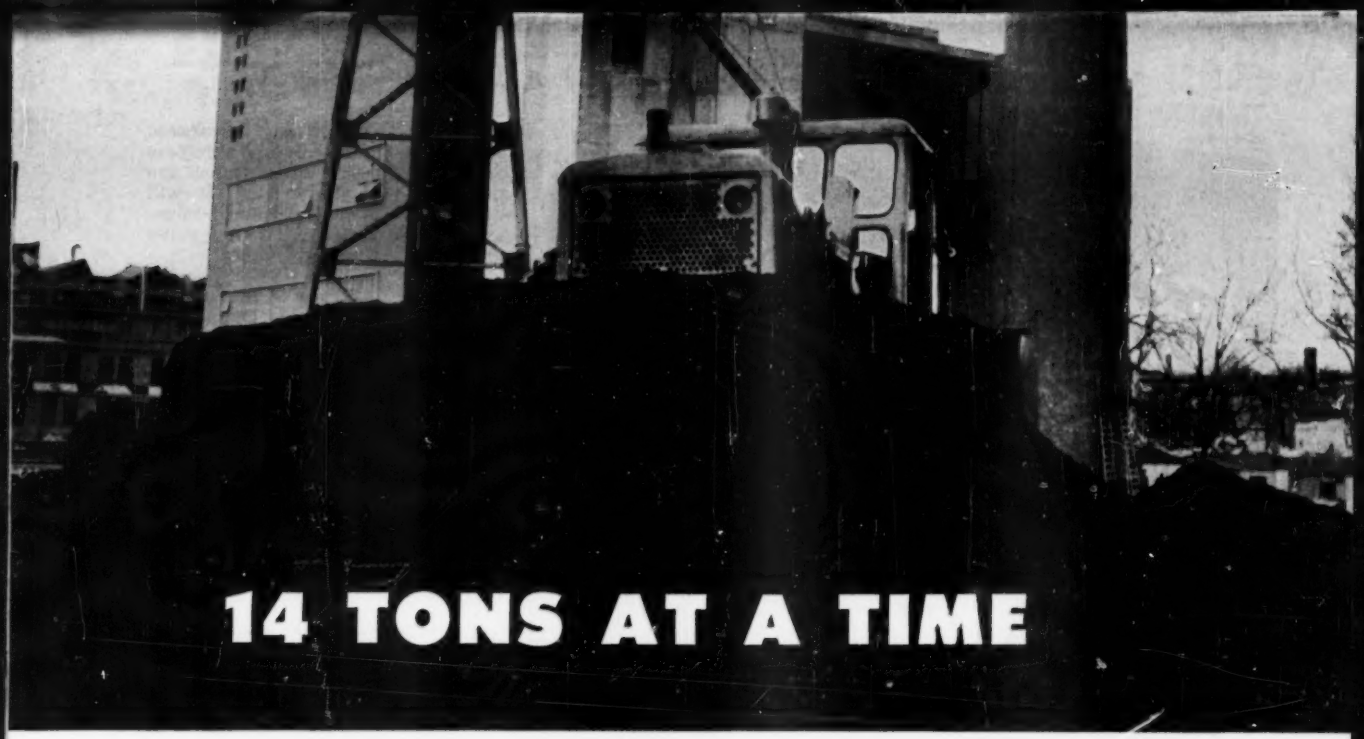
**Speed and Load:** Speed is important since the greater the speed the more frequent will be the shock on each link. Whether or not shocks of this nature will be detrimental to lubrication depends on the load and constancy of operation. Unless loading is very heavy, a re-forming procedure goes on within the oil film between the pins, bushings and other component parts of the chain. Chain authorities agree that a fluid oil at the operating temperature lends itself best to this film re-forming process through capillary action. Conversely, increasing the viscosity of the lubricant to any great extent as is sometimes done on heavily loaded bearings would be bad in a chain link mechanism. It is customary to assume that the usual practice of reducing load with increased speed will reduce link shock to keep within the required factor of safety, and to insure continued effective lubrication.

**Effect of Joint Articulation:** Bending or articulation of a driving chain imposes wear not only on the link pin bearings, but also at the points of contact between chain and sprocket teeth. In fact, this is the chief cause of external wear, both of chain and sprocket, notwithstanding that correct chain design tries to eliminate this tendency towards friction and external wear, confining any necessary rubbing or rolling to the joints.

To this end, pins, bushings, rollers, etc. are built with adequate bearing surface to take up the usual strains. Still, a certain amount of external wear will be present in any case, and for this reason an adaptable chain lubricant should serve both internal and external wearing points.

**Clearance and Lubricant Penetration:** Depending upon the existing clearances, the lubricant must have enough fluidity to penetrate thoroughly throughout the entire link whether pins and bushings, rollers or rocker joints are involved. On the other hand, detachable or pintle type chains may require a heavier grade of lubricant than would be used on a roller or silent chain to enable it to resist the effects of centrifugal force and stick to the wearing surfaces.

Grit, dust, acids and moisture will increase wear and corrosion to a marked extent. Grit and dust in particular, being extremely penetrating,



# 14 TONS AT A TIME

## 70 tons of coal stockpiled in 5 passes by Allis-Chalmers HD-20 Tractor with Special Coal Blade

COAL is brought to the power plant of a large northern Indiana industrial plant by rail. Cars are dumped over hoppers and coal not needed immediately at the plant is stockpiled.

As this coal flows from the stacker it is dozed out over the stockpile by an Allis-Chalmers HD-20 Tractor equipped with specially designed Baker coal blade. The coal from 70-ton cars is moved 150 to 200 ft. in five passes, coal from two 50-ton cars takes seven passes — an average of 14 tons at a pass.

### Tractor Compacts Coal

The coal is well compacted to help prevent spontaneous combustion, through the repeated trips of the heavy tractor over the stockpile. Complete with blade, the unit weighs approximately 25 tons — enough to tightly pack the horizontal layers of coal and eliminate the flues that often lead to burning.

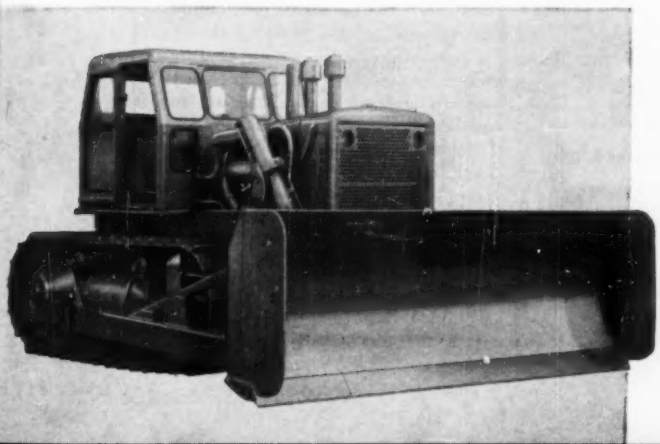
With a 175-hp. diesel engine, the tractor has plenty of power for moving big loads. A hydraulic torque converter drive multiplies torque up to four and a half times where needed to start the load of coal, then automatically accelerates to the highest traveling speed that conditions permit.

### Has Hydraulic Steering

Convenience of operating and servicing the HD-20 Tractor also contributes to its high over-all output. Hydraulic control permits steering with the touch of a finger. Other operator conveniences include comfortable seats, clean platform and excellent visibility. For simplified repair, major tractor assemblies are easily removed without disturbing adjacent parts. Truck wheels, idlers and support rollers need be lubricated but once in 1,000 hr. There are no lubrication fittings under tractor.

Additional information about this HD-20 Tractor and coal blade — or about the three other Allis-Chalmers tractors, tractor shovels, scrapers and motor scrapers for stockpiling coal — can be obtained from an Allis-Chalmers dealer or direct from the company.

Big Allis-Chalmers HD-20 Tractor has 175-hp. diesel, weighs 25 tons complete with blade. Baker coal blade has extra, 56-in. height and 14-ft. length, plus boxed-in ends that help carry 15 to 20 percent larger load than regular blade.



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THE highly accurate EYE-HYE manometric gage has supplied reliable boiler water level indication on panel boards or other remote locations for more than 15 years. Now you can have auxiliary light signals or audible alarms anywhere in your plant, dependably operated by an electronic hook-up with the EYE-HYE.

Probes extending into the window unit and the calibrating tube complete an electrical circuit at the level of the indicating fluid. The signals or alarms coincide exactly with the reading in the always-accurate EYE-HYE. This new facility, added to the popular EYE-HYE, in no way interferes with the reliable operation of the remote gage.

With a two-light Levalarm Light Indicator, the red light warns of dangerously high or low water levels, the green light indicating a safe level. Vibratory electric horns or bells can be used in addition or instead of light signal.

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will tend to work into clearance spaces and immediately increase wear. Unless the lubricant has the proper viscosity and base, it will often mix with such grit and become an abrasive paste similar to a valve grinding compound.

Grease lubrication is practicable under such conditions for some types of chains. It is true that chains with greasy exteriors pick up dirt and grit, but this is offset by the fact that grease in the clearances seals against entry of abrasive materials. Furthermore the clearances between chain link plates, and between the ends of chain rollers and in the inner faces of roller link plates are so small (of the order of a few thousandths of an inch) that edge filtration is developed. Obviously a grease lubricated chain in such service should be cleaned thoroughly at regular intervals.

For illustrations the author is indebted to Diamond Chain Co., Inc., Link-Belt Co., Ramsey Chain Co., Inc., Whitney Chain Co., Chain Belt Co., and the Morse Chain Division of Borg-Warner Corp.

## *New* ENGINEERING BOOKS

**Pumps,** Second Edition, by Frank A. Kristal and F. A. Annett, 373 pages, illustrated, size 6 by 9¼ ins., cloth binding. Published by McGraw Hill Book Co., 330 E. 42nd St., New York 36, N. Y. Price $6.50.

Millions of pumps are produced in the United States each year, ranging in size from units requiring flea power to drive them to those requiring several thousand horsepower.

This book is devoted to medium and small-sized pumps, giving detailed descriptions of type and design, and telling how to select, install, operate and maintain them. Attention also is given to the location and remedy of pump troubles.

Applications such as boiler feed, deep wells, sumps and sewage have been treated in separate chapters.

The authors discuss very completely what may be expected of the various types in performance, as well as their service limitations. To understand cost of pumping, factors such as sizes of pipes, estimating head against which they must work, and so on, must likewise be understood, and these are treated extensively.

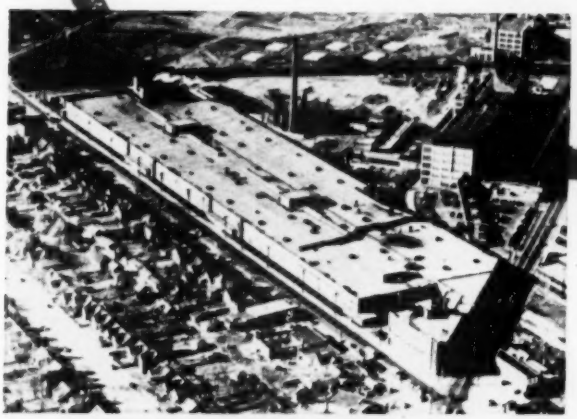
Since the authors have tried to present the subject from the practical man's viewpoint, mathematics have been avoided except where deemed absolutely necessary.

★ ★ ★

**Trane Air Conditioning Manual,** Revised; 380 pages; size 8½ by 11¼ ins., illustrated, cloth binding. Published by The Trane Co.,

# 7 DETROIT STOKERS

## in two *Eli Lilly and Company plants*



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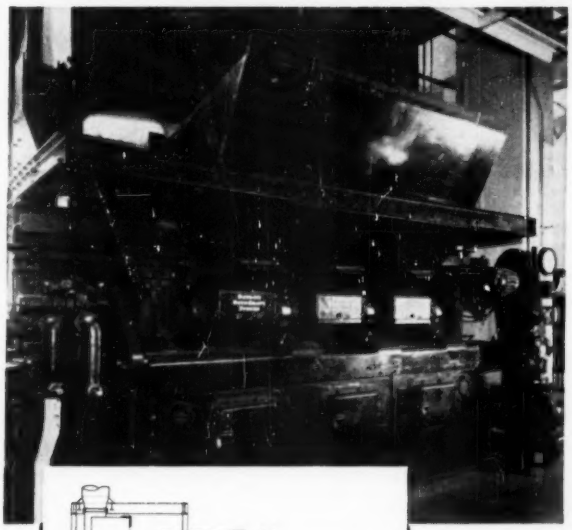
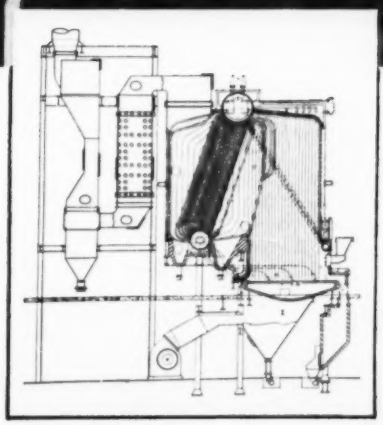
*Cleanliness—elimination of sources of possible contamination—is of paramount importance to plants making thousands of medicinal products having the highest reputation for purity.*

*At the left one of the two Detroit Roto-Grate Stokers at the Lilly Indianapolis plant. Capacity each Babcock and Wilcox unit 75,000 pounds per hour. RotoGrates also are in service at their new Tippecanoe Laboratories, Lafayette, Indiana.*





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La Crosse, Wis., March, 1953. Price $5.00. New fan chapter available separately for $1.00; 50 cents if manual purchased within six months of publication date.

This book, now in its 16th printing, has been used as a standard text and source reference on air conditioning by colleges and universities. The publishers now have added a new fan chapter to cover fan application and selection, basic fan laws and duct design data and nomenclature. The revision adds to the manual extensive information on design of air handling systems for air conditioning.

Beginning with a simplified presentation of the basic physical laws governing heat and cold, the manual applies these laws to practical problems in air conditioning.

A chapter on comfort and physiology of human heat control mechanism illustrates comfort standards. Other chapters on heat gain and loss properties of air and the psychometric chart, refrigeration and calculations for the conditioned air supply are among those given in the book on basic air conditioning system design and equipment application.

The text is illustrated with drawings, photographs, charts and graphs. Problems at the end of each chapter show practical applications; answers are given in a separate section.

A reference section contains standard tables on air, refrigerants, pipe capacities for refrigerant liquid and vapor and ducts.

★ ★ ★

**Simplified Drafting Practice,** by W. L. Healy and A. H. Rau: 156 pages; illustrated; size 9½ by 11 ins., cloth binding. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price $5.00.

How General Electric Co., through adoption and extension of simplified drafting practices, made substantial savings in time and money, is presented here as an aid to engineering and drafting organizations.

Primary purpose of industrial drafting is to convey engineering instructions concerning size, shape and material requirements of a part or assembly to make easier its manufacture. To do this, industrial work drawings must describe so simply and clearly that there can be no question as to requirements to be met in the manufacture and installation of the product.

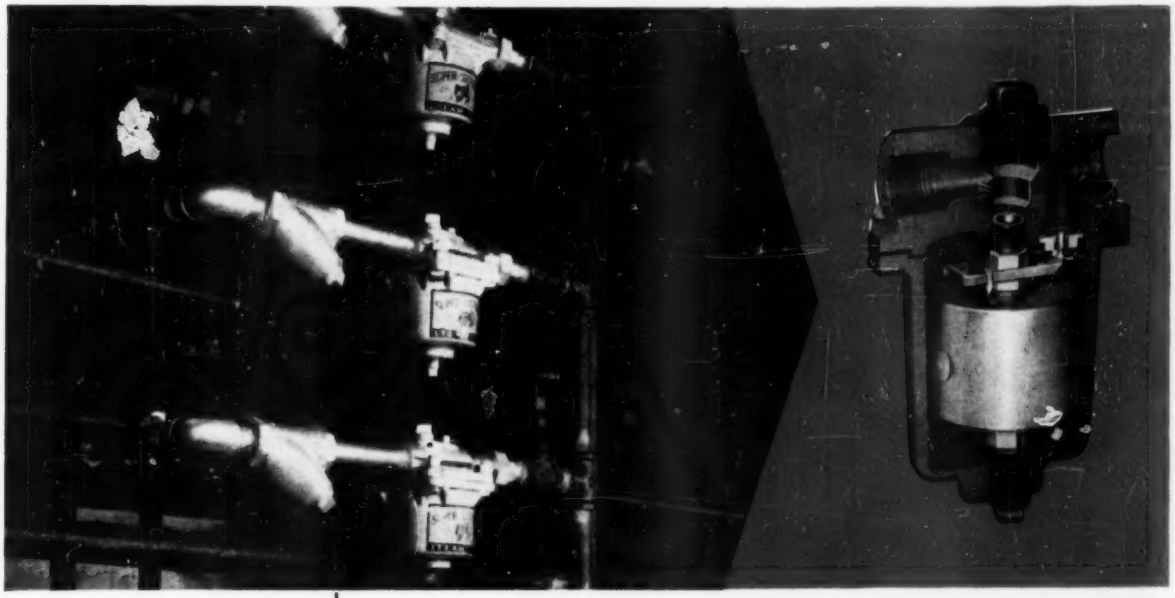
How to do this, as well as ways and means of reducing time and effort required to make the drawings through simplified drafting methods, elimination of non-essentials, and extensive use of freehand drawing are told here.

Co-author Healy is Supervisor of Technical Service, Switchgear Department, General Electric Co. at Philadelphia, and was recently elected president of the Standard Engineers Society.

Mr. Rau is manager, Drafting Services Section, Engineering Services Division at General Electric and is responsible for the coordination of drafting organizations, practices and procedures for the entire company.

# CONTROL IS VITAL

*in steam traps, too!*



**The inverted bucket in SUPER-SILVERTOPS Does Not Swing Free...Guided Action Assures Positive Valve Closing**

Control is mighty important . . . whether you're paddling a canoe or building a steam trap. Anderson engineers have carefully designed Super-Silvertops so that the operating action is controlled at all times. This means that the bucket in a Super-Silvertop, unlike other inverted bucket traps, does not swing free. It's carefully guided on a hexagonal tube, minimizing friction. The bucket cannot get out of alignment, hit the case of the trap, or cause the valve to improperly seat and leak steam. This unusual patented feature is another reason you get more for your money with Super-Silvertops. Why be satisfied with anything less than the best? Contact your local Super-Silvertop representative or jobber today.

*Quality Steam Traps since 1886*

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THE "CONTROLLED" STEAM TRAP

**STEAM UNITS HEAT UP 8 TIMES FASTER WITH SUPER-SILVERTOP SERIES B TRAPS**

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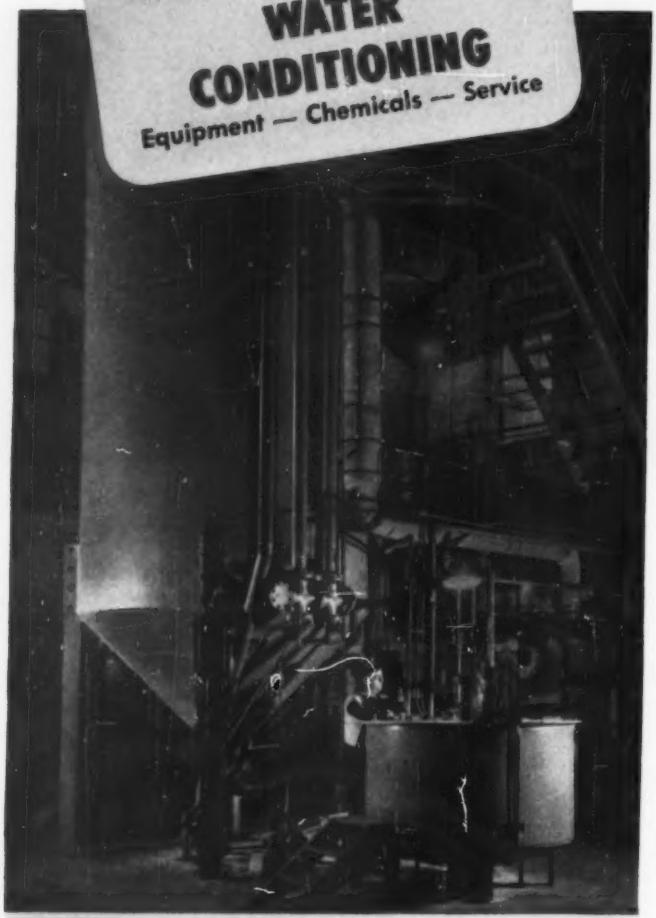
# Gilbert Paper Co., Menasha, Wis.

# Prevents SCALE and CORROSION




Equipment at Gilbert Paper Company includes hot process lime-soda softener and chemical feeder. For more information on this process, write for Bulletin 28B6611.

**To prevent** scale and corrosion in water used for steam generation, Gilbert Paper Company removes mineral constituents and dissolved gases by using Allis-Chalmers hot process lime-soda water conditioning. As a result, boiler outages and maintenance are greatly reduced. The process is the same as that used in many installations for process water.

### What Hot Process Lime-Soda System Does

The complete installation heats water to the boiling point for removal of corrosive gases. Proportioning equipment introduces chemical reagents continuously and precisely into the water being treated. Precipitate induced by the thermo-chemical reaction is coagulated, settled, and separated from the water, which is then ready for use in steam generation. Apparatus includes a chemical solution tank, chemical proportioner and pump, reaction and sedimentation tank, pressure filters and accessories.

### How You Can Solve Your Water Problems

If you have a water problem, you'll find Allis-Chalmers complete service a useful addition to your power or process water operations. Many years of experience plus a complete line of equipment and chemicals enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.

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# ALLIS-CHALMERS

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## HELPFUL BULLETINS

(*Continued from page 36*)

are designed, how they operate, and how they are installed. Typical applications are diagrammed and installations are pictured. Includes detailed information on temperature compensating unit for higher pressure applications. Yarnall-Waring Co.

**134 Flow Meter** — Eight-page booklet 52-1017-37 describes a meter for measuring air and gas flow and ratio of air to gas flow. Shows how meter can be used in connection with industrial furnaces and sewage disposal plants; also in cost accounting, to accurately meter and charge cost of air delivered. Hays Corp.

**135 Oxygen and Combustibles Analyzer** — Application, special features and operating characteristics of an oxygen and combustibles analyzer are discussed in Bulletin CE65-1A. Diagrams show complete sampling and indicating-recording system, also measuring process from gas sample through transmitted electric signals. Bailey Meter Co.

**137 Control of Cooling Water** — Instrumentation Data Sheet 9.6-7 describes the completely automatically controlled feeding of sulfuric acid and sodium dichromate, and continuous regulation of blowdown using a recording and indicating potentiometer with Air-O-Line control. Industrial Div., Minneapolis-Honeywell Regulator Co.

**138 Carbon Dioxide Meters** — Folio 406 describes the operating principle and important features of company's $CO_2$ meters, picturing several models and illustrating a typical installation. Size and weight of these motor-driven meters are listed. Republic Flow Meters Co.

**139 Industrial Inferential Meter** — Bulletin 500, 16 pp, describes company's Type MO meter, with data on operation, construction, accuracy, primary devices. According to catalog, meter, available in indicating, recording and totalizing form, can be operated as direct mechanical instrument or as electric or pneumatic transmission device. Simplex Valve and Meter Co.

**140 Electronic Controls** — Eight-pp Catalog F 6166 describes flexibility of an electronic controls system for heating, ventilating and air conditioning. Describes temperature controls, control panel, sensing elements, as well as the ultra-sensitive micro relay which simplifies the amplifier. Barber-Colman Co.

**141 Automatic Combustion Control** — Bulletin C-101 describes and pictures controls for oil, gas, or coal fired boilers to achieve efficient and economical steam generation. These include master regulator, air-flow and draft regulators, sequence draft regulator, loading transmitter. Reliance Instrument Mfg. Corp.

**142 Magnetic Oxygen Analyzer** — Oxygen recording equipment which helps maintain correct $O_2$ for combustion and in various plant or process operations is described in Bulletin ND46-91(3). Explains how paramagnetic principle works, how it is utilized. Leeds & Northrup Co.

### DIESELS

**143 Two-Cycle Diesel Engines** — How higher output and savings are effected by the company's TS-21 diesel engine is discussed in Bulletin 224A. Typical installation pictures show applications of various size engines in municipal power plants, central stations, and industrial power plants. Nordberg Mfg. Co.

**144 Diesel Electric Sets** — Emergency power for hospitals through installation of automatic controls is discussed in 8-pp Bulletin 30789. Advantages of these sets, stressed in catalog, are automatic starting and handling of power loads within seconds after commercial power failure. Caterpillar Tractor Co.

### OTHER EQUIPMENT

**145 Wall Deslaggers** — Bulletin 1016 shows how dual-motor drive and high striking power are combined to stop water wall slag build-up. Bulletin is illustrated with sketches and cutaway views showing accessibility. Copes-Vulcan Division, Continental Foundry and Machine Co.

**146 Liquid Seals** — Bulletin 241 tells how to keep high pressure refrigerant gas out of the evaporator when liquid level in receiver drops below the outlet pipe. Covers operation, selection and installation of cast semi-steel and forged steel liquid seals and expansion valves. Includes selection charts for ammonia, Freon and Carrene refrigerants. Armstrong Machine Works.

**147 Tubing for High Temperatures** — Power engineers associated with equipment operating at elevated temperatures or pressures will be interested in 6-pp Folder TDC 163. Gives condensed technical data on 14 tubing steels. Information on analyses, mechanical and physical properties included. Tubular Products Div., The Babcock & Wilcox Co.

**148 Air Conditioning Filters** — Bulletin 600, 8 pp, describes company's Staynew ventilation and air conditioning filters. Specifications, engineering, performance, and installation data covering dry type panel filters for removing airborne impurities given. Dollinger Corp.

**149 Communication Equipment** — Two new specification sheets describe ultra-high-frequency equipment for two-way radio communication. Catalog C-13 deals with mobile radio equipment. Catalog C-15 describes a desk type unit transmitter-receiver housed in a compact cabinet to suit station use, and designed to accommodate four-frequency operation when required. RCA Victor Div., Radio Corp. of America.

**150 Hot Water Heater Code** — Twenty-pp Bulletin 11 is a newly revised edition of the "Standard Code for Testing and Rating Hot Water Unit Heaters," and it uses present-day instrumentation and practices. Provides a standard method of testing and establishing capacities and performances of hot water unit heaters. Covers equipment for testing, procedure, computation of tests. Booklet is issued jointly with the American Society of Heating & Ventilating Engineers. Industrial Unit Heater Assn.

**151 Split Roller Bearings** — This 16-pp illustrated catalog presents anti-friction bearings "split right down to the shaft" to permit use of anti-friction bearings in many difficult applications. Design details and types available are described and illustrated and full dimensions included. Booklet also gives selection suggestions for getting the right bearing for the job. The Cooper Split Roller Bearings Corp.

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# Catalog Library

**THIS MONTHLY list of standard catalogs and bulletins is published to help power engineers maintain a permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, may appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the catalogs and bulletins. Use the postage-free card below for your request**

## PUMPS, PUMPING

**201 Condensed Pump Data** — Form 4383-J covers more than 20 types of general service pumps, rotary pumps, sump and drainage pumps, condensate units, self-priming units, stainless steel pumps and high pressure pumps. In easy-to-find tabular form, each model is pictured along with its characteristics, applications, features and references to specific literature. Goulds Pumps, Inc.

**202 Boiler Feed Pump** — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up, is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

**203 Gear Pumps** — Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities. Schutte and Koerting Co.

**204 Boiler Feed Pumps** — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data and vapor pressure tables included. Pacific Pumps, Inc.

**205 Controlled Volume Pumps** — Motor-driven controlled volume pumps are fully described in 40-pp Bulletin 553. Provides information on design and construction of the pumps, and includes capacity-pressure selection tables, types of capacity adjustments, standard and special designs and packaged systems. A chart shows typical applications in six major industries, and another chart, in full color, shows construction materials suited for use with some 170 industrial fluids. Milton Roy Co.

## PACKINGS, GASKETS, SEALS

**206 Packings and Gaskets** — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

**207 Seals for Bearings** — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

**208 Packings for the Power Plant** — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial power plant with each unit keyed to the proper packings and gaskets. Illustrated. Includes construction information, sizes. Johns-Manville.

**209 Long Wearing Piston Packing** — Form 4502, 8 pp, presents composition cups for packing pistons of air and hydraulic cylinders and reciprocating pumps. Engineering information covers properties, textures, temperature and pressure data, sizes. Darling Valve & Mfg. Co.

## INSTRUMENTS AND CONTROLS

**210 Supervisory Instruments** — Catalog 90-2. "Supervisory Instruments for Power Generation," consists of 41 pp on the instrumentation involved in generating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation and other variables discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

**211 Instruments Control Systems** — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls. Republic Flow Meters Co.

**212 Control Centers** — This 31-pp application booklet (B-5621) on control centers stresses the case for centralizing all controls of an entire system in one group of enclosures. Discusses the characteristics of control centers that make for flexibility of use, ease of servicing, safety. Three types are described, and the various electrical components that make up typical units are illustrated. A three-step building-block system of planning control centers is given. Westinghouse Electric Corp.

**214 Metering and Control Equipment** — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, and detailed literature references included. Bailey Meter Co.

**215 How to Select Regulators** — This 36-pp, illustrated "step selection chart" simplifies choice of proper type and size of pressure regulator, temperature

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**December 1953**
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regulator or pump governor to do a specific job. Written in nontechnical language and supplemented by steam, gas and water capacity tables, this booklet includes installation suggestions, conversion tables and other data. Foster Engineering Co.

**216 Steam Specialties** — Catalog 53, 62 pp, describes a line of steam, gas, air, oil and water regulating equipment. Includes complete specifications, operational data and prices on pressure regulators, temperature regulators, combination pressure-temperature, instruments, diaphragm valves, motor operated valves, float valves, safety and relief valves, strainers, solenoid and motor valves, water gages. Provides capacity tables, flange charts. O. C. Keckley Co.

**217 For Combining Control Signals** — The improved design of company's Ratio Totalizer is described and pictured in 8-pp Bulletin 5452. This simplified versatile mechanism is a pneumatically operated control for combining input control pressures and spring forces, and producing an output control pressure based on addition, subtraction, multiplication, division or other functions. Hagan Corp.

**218 For Feedwater Analysis** — Bulletin 148 BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both $O_2$ and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

**219 Electronic Feedwater Control** — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are told, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

**220 Boiler Control** — Ten-pp Bulletin 1007 describes a completely integrated system for controlling combustion, feedwater, boiler steam temperature and boiler cleaning, available in a single package or furnished separately. Illustrated with full color drawing of complete control, photos of recorders, drive unit. Covers instrumentation with both miniature and standard instruments. Copes-Vulcan Div., Continental Foundry & Machine Co.

**221 Easy Reading Gage** — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

## ELECTRICAL

**222 Electrical Maintenance Tips** — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors and controls is provided. Westinghouse Electric Corp.

**223 Wire, Cable Ordering Guide** — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. Available to qualified power engineers. United States Rubber Co.

**224 Power Distribution Practices** — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

**225 Motor-Generator Reference Book** — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control, general characteristics and representative dimensions. Allis-Chalmers Mfg. Co.

## WATER CONDITIONING

**226 What's What on Ion Exchangers** — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

**227 Modern pH and Chlorine Control** — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

**228 Water Conditioning Data Book** — Recently revised, this pocket-size 116-pp booklet presents a compilation of 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater makeup requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

**229 Data on Zeolite Softeners** — Publication 4520-A is a 32-pp well illustrated booklet on zeolite water softening. Provides a glossary of terms used in the process, data for laying out a zeolite softening plant, factors governing size of equipment, selection of zeolite materials and discussion of the operating stages of a sodium zeolite softener. Cochrane Corp.

**231 Steam System Treatment** — This bulletin on Coravol for prevention of corrosion, explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

**232 One-Minute Water Tests** — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50. Procedures, reagents, and equipment are described. Hall Laboratories, Inc.

**233 Boiler Scale — Formation and Prevention** — Technical Paper 98 is a 12-pp article covering the cause and prevention of boiler scale. Covers the mechanism of scale formation, effect of boiler scale, chemistry of scale formation, internal chemical treatment and chemical correctives. Diagrams of feeder systems, photos and solubility charts illustrate text. W. H. & L. D. Betz.

**234 Boiler Water Manual** — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and feedwater system, condensate returns. % Proportioneers, Inc. %

**235 Water Treatment** — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

**237 Corrosion Treatment** — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising pH value of condensate. The Bird-Archer Co.

## BOILERS, GENERATORS

**238 Improved Steam Generator** — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions and standard and accessory equipment for the units which range from 20 to 6000 hp, for pressures to 250 psi. Preferred Utilities Mfg. Corp.

**239 Shop-Assembled Boiler** — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions and weights given. The Babcock & Wilcox Co.

**240 Steam Generators** — Illustrated Bulletin S343, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas

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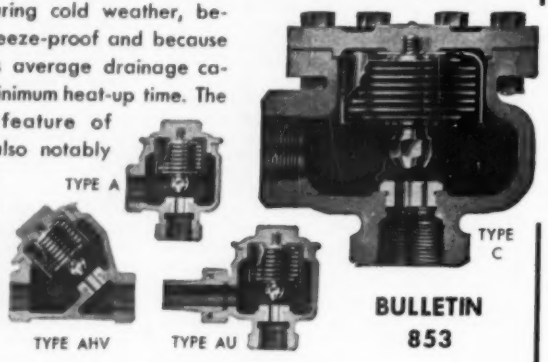


BULLETIN 853

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travel. Use of generator with various fuels and firing arrangements is covered. Erie City Iron Works.

**241 Steam Boilers** — Form SG 128-749 is a 12 pp catalog illustrated with photos of steam boilers for processing and heating, ranging from 15 to 500 hp and 15 to 200 psi. Includes diagrammatic cross-section of four-pass design characteristic of company's boilers. Cleaver-Brooks Co.

**242 Packaged Boilers** — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

## REFRACTORIES, INSULATION

**243 Refractory Cements** — Sixteen-pp Form 863, presenting a line of refractory cements, discusses the three basic materials used in them, provides a detailed selection guide and illustrated discussion on methods of preparation and installation. Also defines terminology. Norton Co.

**244 Heat Insulation Data** — This is a 12-pp illustrated engineering and specification manual describing applications for 85 per cent Magnesia heat insulation. Provides data on heat savings per pipe thickness, for heat ranges to 600 F. Includes charts for determining thickness standards for pipe covering, with tables for heat calculations. Mundet Cork Corp.

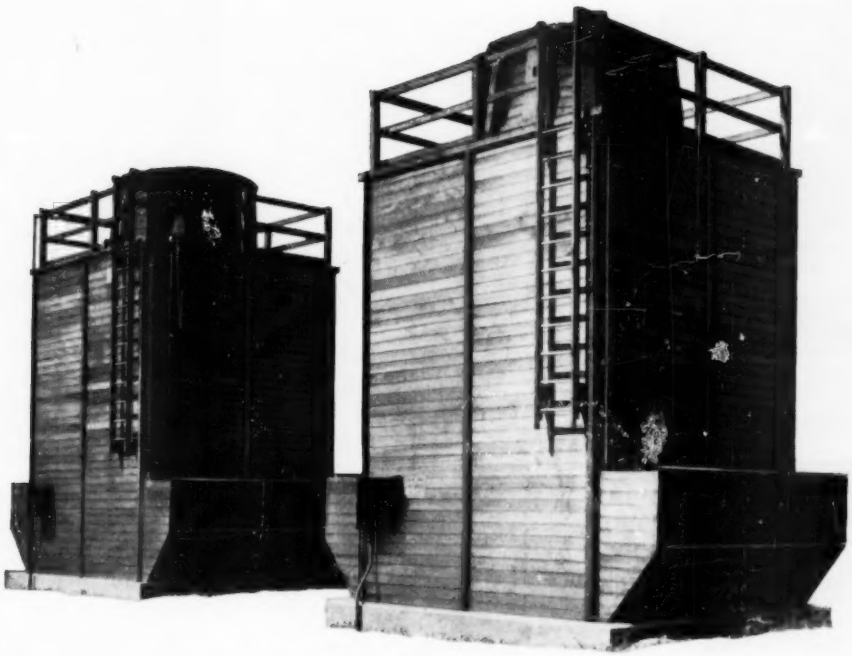
## TUBING AND ACCESSORIES

**245 Condenser Tubes** — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper installation are presented, as are specifications, conversion tables, and weights. Scovill Mfg. Co.

**246 Life Extension for Condenser Tubes** — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

**247 Nickel Pipe and Tubes** — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

**248 Double-Walled Tubing** — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.



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*Leaf assembly being removed from one of three vertical filters at B. F. Nelson.*

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**249 Tube Cleaners** — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc

**250 Rotary Tube Cleaners** — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads discussing special features. Roto Div., Elliott Co.

**251 Data on Stress Values** — Data Card 154 is designed to help power engineers concerned with the operation of tubular equipment at elevated temperatures and pressures. The card is an adaptation of Table P-7 of the new ASME Boiler Code and is complete with notes and formulas for calculating maximum allowable working pressures. Tubular Products Division, The Babcock & Wilcox Co.

### COAL, ASH HANDLING

**252 Economic Coal Storage** — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

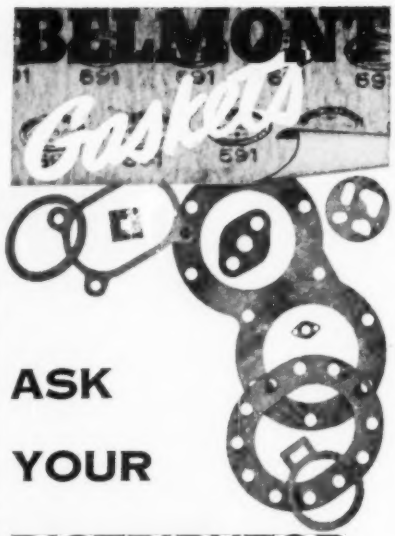
**253 Spreader Stoker Data** — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

**254 Spreader Stoker** — Sixteen-pp Bulletin 800 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lb of steam per hour. Detroit Stoker Co.

**255 Spreader Stoker Selection** — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

**256 Automatic Coal Scale** — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

**258 Shredder Ring Crusher** — A crusher for coal and similar materials which features rolling shredder rings is described in this 8-pp bulletin. Gives details on a survey of 29 mines and power plants in which this type crusher is installed. Informative tables giving speed, capacity, horsepower, weight and dimensions of crushers, as well as cost data are included. American Pulverizer Co.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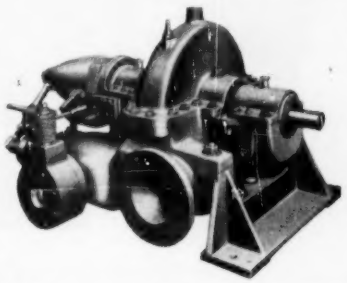
This important refinement exemplifies the thoroughness of Westinghouse continuing program to build more and more efficient prime movers. A program based on—over 50 years' experience in turbine design and manufacture . . . research and development skill . . . complete production facilities . . . full-scale floor testing . . . quality components . . . wide range of capacities, from 1 hp to the largest made . . . and expert field and application ability.

## The Type E General-Purpose Turbine



Type E-116 is the smallest member of the Type E family and is rated up to 500 hp. It is a typical product of Westinghouse engineering progress and includes these important features: dual protection against overspeed; weather-resistant construction; centerline support and interchangeable parts. Other Type E sizes are also available, with ratings through 1500 hp, to cover a wide variety of applications.

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**259 Ash Handling Systems** — This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions are included. Beaumont Birch Co.

**260 Fly Ash Elimination** — This 30-pp booklet presents manufacturer's "Multiclone" equipment (described as small-tube type of cyclonic dust collectors using centrifugal force for separating dust from gas stream) as a highly successful and economical means of separating fly ash — not as a panacea for all cinder and fly ash problems. Also gives data on single and double hopper installations. Western Precipitation Corp.

## GAS AND OIL BURNERS

**261 Gas Burners** — Illustrated Bulletin 410-8, 16 pp, furnishes descriptive and technical data on company's gas burners and combination gas and oil burners, giving design details and explaining operation of each. Coppus Engineering Corp.

**262 Oil Burning Equipment** — Bulletin O-B 37 contains 16 pp of technical information on company's oil and gas burning equipment, steam atomizing burners, mechanical atomizing burners, interchangeable burners, telling best applications, including capacity data. Also shows heating systems. The Engineer Co.

**263 Steam Atomizing Oil Burners** — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. National Airoil Burner Co., Inc.

## FUEL OILS, LUBRICANTS

**264 Air Compressor Lubrication Manual** — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

**265 Diesels, Their Fuels and Lubricants** — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. Sinclair Refining Co.

**Postage-free cards for ordering these catalogs are on pages 35 and 134. When using them, don't forget to include your job title and company name—even if you want those catalogs to be delivered to your home address**

**266 Versatile Industrial Oil** — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

**267 Turbine Lubrication** — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations, photos of purifiers. DeLaval Separator Co.

**268 Cooperative Technical Consultation Service** — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

**269 Turbine Oil Conditioning** — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil. Bowser, Inc.

**270 Petroleum Pitch** — This illustrated article on petroleum pitch as a boiler


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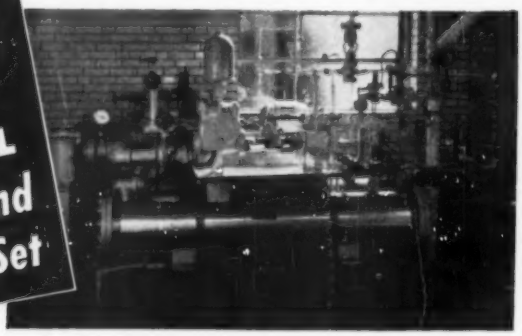
DUAL FUEL-OIL Heating and Pumping Set



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fuel stresses its low cost, other advantages. Explains combustion of pitch; discusses unloading method, burning, storage, fuel oil treatment, also precautions in handling hot pitch. Kor Corp.

## HEAT EXCHANGING, COOLING

**271 Heat Exchangers** — The advantages of film-type heat exchangers in the solution of cooling water problems, even when dirty water must be used, are stressed in Bulletin HE-7, 8 pp. Explains and illustrates design details. Discusses use of these heat exchangers in power plants, chemical plants, and in a compression plant. Henry Vogt Machine Co.

**272 Finned Tube Heat Exchanger** — Bulletin 1400, 20 pp, fully describes the company's G-R Twin G-Fin Section heat exchanger. The unit has wide application for heating and cooling liquids and gases, and for condensing vapors, according to the company. Suitable as boiler feedwater preheaters, fuel oil heaters, etc., features of design and construction are given. Griscom-Russell Co.

**273 Air-Cooled Heat Exchangers** — Technical Bulletin R-53-DC1 is a 6-pp illustrated article on the economics of the air-cooled heat exchanger for process cooling. Discusses air-cooled exchangers and their selection, gives design details that affect cost and evaluates operating costs. The Marley Co.

**274 Heat Exchanger for Process Industries** — Bulletin HF-101, 8 pp., describes the Holo-Flight Processor. Tells how this heat exchanger affords control of the flow of material as to duration of treatment, and control of the quantity and temperature of heat exchange agent. Western Precipitation Corp.

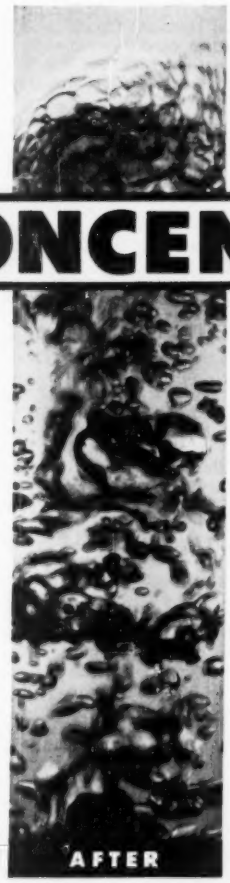
## VALVES, TRAPS, PIPING AND ACCESSORIES

**275 Check Valves** — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

**276 Safety Valve Engineering Data** — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, also provides tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

**278 Cast Steel Valves** — This 56-pp catalog on cast steel valves includes information on globe, angle and check valves in 300, 600, 900 and 1500 lb pressure classes. Parabolic disc valves for hand or motor control of volume are also described. In addition to standard information on construction features, dimensions and weights, the booklet contains complete data on material specifications, preparation of welding ends, flange facings, and ratings. Edward Valves, Inc.

**279 Lubricated Plug Valves** — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.




Laboratory demonstration shows foaming of highly alkaline solution in glass test cylinder.

Same solution after addition of 12 ppm of Bird-Archer Concentrol antifoam.

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**280 Pressure Reducing Valve** — Bulletin 228, 8 pp, describes and pictures a pilot-operated pressure reducing valve designed for automatic control of reduced pressure required in steam service. Gives advantages of the valve, illustrates method of installation. McAlear Mfg. Co.

**282 To Get at Those Valves** — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

**284 For Precise Control** — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manuals and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages of the valves are discussed. R. S. Products Corp.

**285 Solving Steam Trap Problems** — This 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

**286 Steam Trap Book** — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

**287 Steam Trap Reference Manual** — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring Co.

**288 Industrial Steam Traps** — Twelve-pp Bulletin 853 describes steam traps with bellows of bronze, Monel or stainless steel, and bodies in bronze, semi-steel and cast steel construction in sizes ¼ to 2 in., for pressures from vacuum to 300 lb. Included besides capacity tables and dimensions are piping diagrams, typical applications, and data covering the selection. W. H. Nicholson & Co.

**289 Piping Pointers** — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8-pp valve selection guide. Crane Co.

**290 Forged Fittings** — Literature is available on screw-end and socket-weld fittings. Stresses economy and other advantages of these fittings, lists steels available. Watson-Stillman.

**291 Unions and Fittings** — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

**292 Handbook on Fittings, Flanges** — Catalog wf-1950, 68 pp, offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

**293 Improved Pipe Hanger** — Twelve-pp Bulletin 153 describes company's Counterpoise pipe hanger for high temperature piping systems in steam generating stations, refineries and chemical plants. Tells how it offers efficient load supporting effort of constant value throughout entire range of travel as pipe expands or contracts because of temperature changes. Graphs for selecting proper hangers, tables of dimensions, plus erection are given. National Valve & Mfg. Co.

## OTHER EQUIPMENT

**294 Turbine Generators** — Bulletin H-18, 40 pp, covers turbine generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings. Elliott Co.

**295 New Engine Developments** — Bulletin S-500-B-55, 12 pp, presents new developments in oil diesel, dual fuel diesel and high compression spark ignition engines. Describes features of modern,


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**299 Ejector Instruction Manual** — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures. Foster Wheeler Corp.

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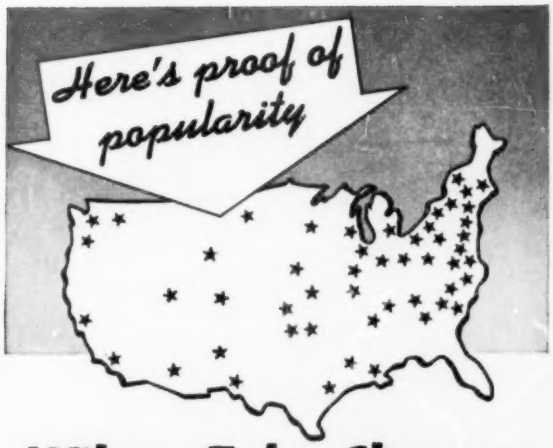


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**HELPFUL-INFORMATIVE IT OUTLINES THEORIES AND BASIC PRINCIPLES OF CENTRIFUGAL DUST RECOVERY!**

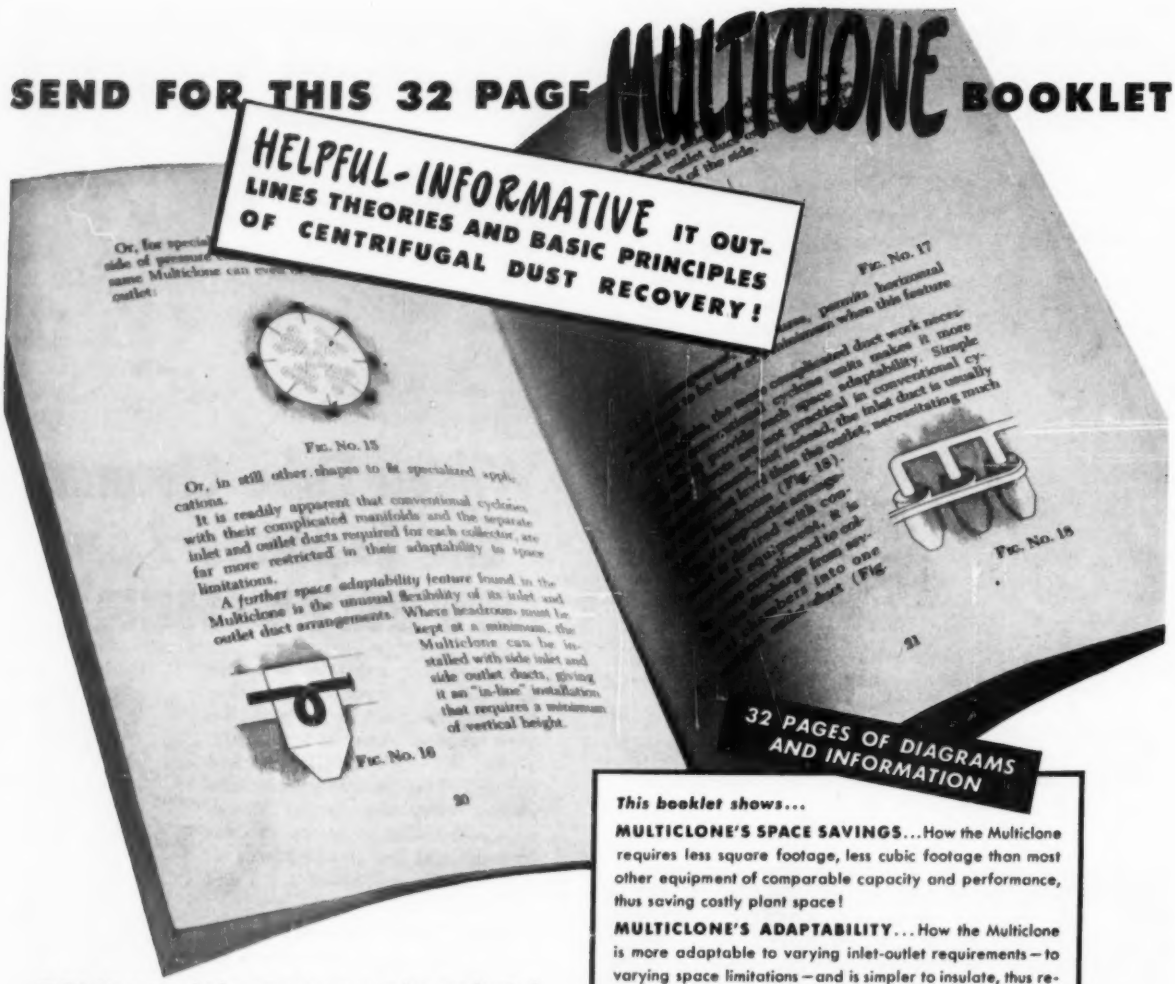
FIG. No. 15
Or, in still other shapes to fit specialized applications.
It is readily apparent that conventional cyclones with their complicated manifolds and the separate inlet and outlet ducts required for each collector, are far more restricted in their adaptability to space limitations.
A further space adaptability feature found in the Multiclone is the unusual flexibility of its inlet and outlet duct arrangements. Where headroom must be kept at a minimum, the Multiclone can be installed with side inlet and side outlet ducts, giving it an "in-line" installation that requires a minimum of vertical height.
FIG. No. 16
20
FIG. No. 17
FIG. No. 18
21

32 PAGES OF DIAGRAMS AND INFORMATION

*This booklet shows...*

**MULTICLONE'S SPACE SAVINGS**...How the Multiclone requires less square footage, less cubic footage than most other equipment of comparable capacity and performance, thus saving costly plant space!

**MULTICLONE'S ADAPTABILITY**...How the Multiclone is more adaptable to varying inlet-outlet requirements—to varying space limitations—and is simpler to insulate, thus reducing installation costs!

**MULTICLONE'S EFFICIENCY**...How Multiclone's multiple *small diameter* tubes, made possible by its exclusive vane design, give higher centrifugal forces and more complete cleansing of *all* suspended particles—even small ones of 10 microns and less!

**MULTICLONE'S LOW MAINTENANCE**...How the Multiclone has no high speed moving parts to repair or replace, no pads or filters to clean or renew, nothing to choke gas flow or increase draft losses as suspended materials are recovered. Multiclone draft losses remain uniformly low—recovery efficiencies uniformly high—at all times!

**Make sure that a copy of this helpful booklet is in your reference files by sending for your copy now!**

NO MATTER whether you are now using mechanical dust recovery equipment or are planning the installation of such equipment at some future date, here is a booklet that is full of helpful and valuable information on centrifugal dust recovery. It not only explains the basic methods and principles involved, but also shows the important differences between small and large diameter separating tubes, shows how to simplify your duct work and reduce installation costs, and outlines many other important factors to be considered in selecting mechanical dust recovery equipment.

In addition, this informative booklet illustrates and explains how MULTICLONE'S unique *vane* design is fundamentally different...how it makes possible greater compactness, simpler installation, high recovery of the small particles as well as the medium and coarser ones, and many other facts on MULTICLONE advanced design.

A limited supply of these booklets is available for free distribution to those interested in mechanical recovery equipment and methods. Write for your copy today.

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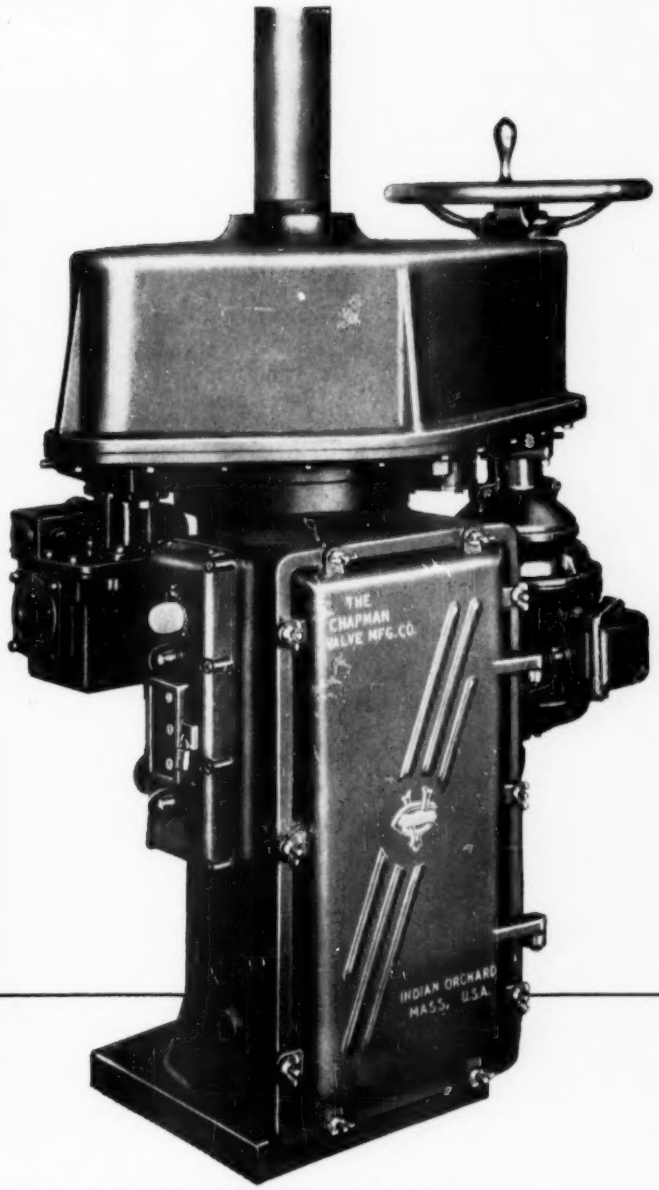


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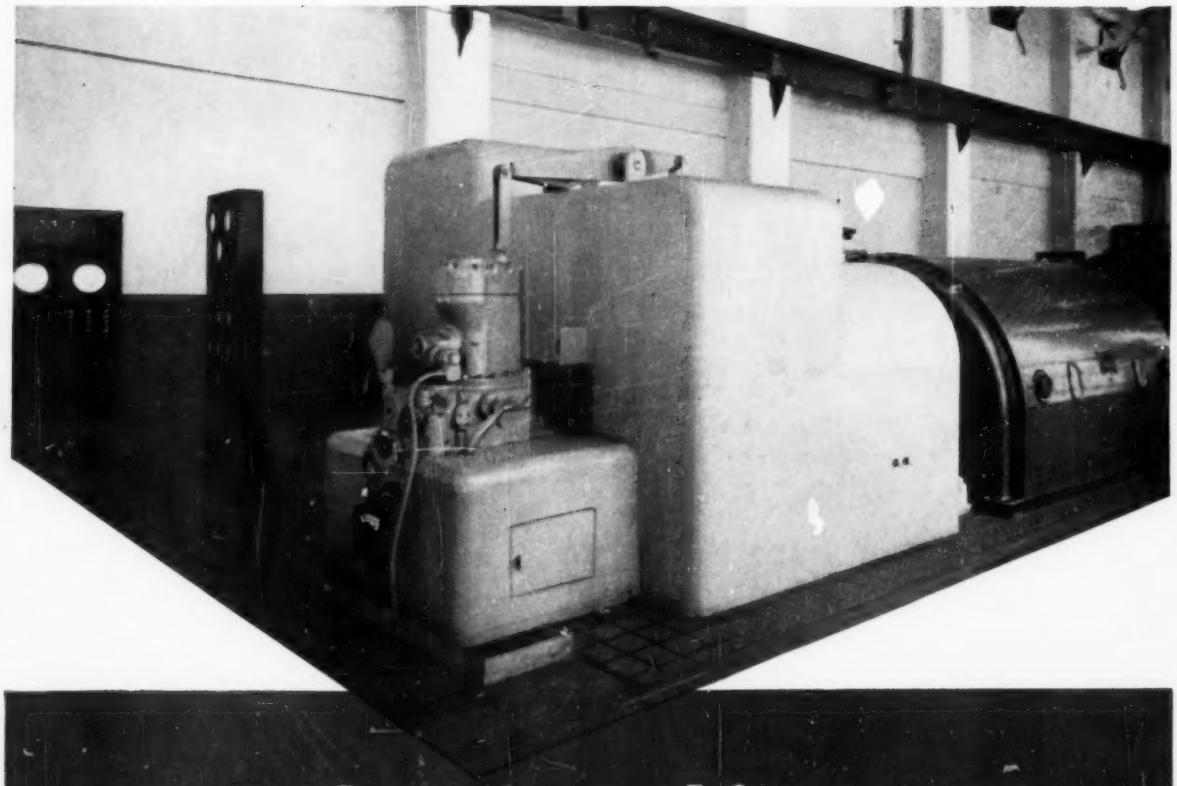

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